Lessons from the Loess Hills

Loess Hills: The Genesis, 1993
Richard E. Leet

"Getting people - getting children - acquainted with what's out here will make people concerned about what is happening here. If we get acquainted with natural communities, we feel at home. Anyplace we feel at home, we feel like protecting."

Sylvan Runkel, from the Loess Hills Seminar

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Funding for developing and writing Lessons from the Loess Hills was provided by a Resource Enhancement and Protection Conservation Education Program (REAP/CEP) grant. Thanks go to the educators who served on the development and writing team:

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Illustrations by Bryan Sacre and Kathy McKee, with special thanks to Richard Leet and Mark Müller for permission to use their work.

The materials were reviewed and edited by Randi Montag- Peterson, whose creativity, research, and attention to detail were major contributions to the success of this project.

Note: For each of the grade level sections in this document, there are activities that focus on the soil, the plants, the animals, and the history of the area. Activities can build upon previous activities as well as be adapted to other grade levels and areas of the state. Activities have been aligned with national standards in science, language arts, mathematics, history, geography, and art.

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Resource Enhancement and Protecton
Conservation Education Programs

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Lessons from the Loess Hills

An Introduction: The Loess Hills

by Thomas C. Bruegger
Director, Monona County Conservation Board

The Loess Hills were formed between 14,000 and 24,000 years ago. During this time, the glaciers were very active and covered a large portion of the northern United States, including northern Iowa. During the summer, the warm air would melt the glaciers creating tremendous flows of water down each river valley, particularly the Missouri River Valley. When the weather became colder, the glaciers stopped melting, exposing huge mud flats. Strong winds sorted the exposed sediments and swept the finer materials from the flood plain into huge clouds of dust, depositing them in the bluffs we now have today. The majority of this silt was deposited on Iowa's side due to the dominant westerly winds. As this silt was accumulated, the bluffs were formed. The coarser silt particles were deposited close to the river bed, which formed the sharply angled and high ridged bluffs along the western edge. As you travel farther east, the bluffs become less sharp, more rolling and considerably lower in height.

There were intervals of inactivity during this formation period. Scientists have found remnants of plants between layers of loess (German word for the rock dust created by the glaciers) which indicate periods when seed germinated and plants grew. Conditions would eventually change back again to create huge dust clouds which inundated the entire Loess Hills region.

The loess soil is composed primarily of quartz that originated from the glaciers. The individual quartz particle is flat sided. Because of this, the loess will retain a vertical face on roadway cuts. There is not another landscape in Iowa where vertical cuts, like ours, are seen. On the other hand, the flat edges easily slide one face against the other which makes this soil type very erosive. The Soil Conservation Service attempts to hold soil losses to five tons of soil per acre per year. It is not unusual that when a rain occurs at a "bad" time in the Loess Hills, 30-35 tons of soil per acre are washed away.

Ridges and cat-steps, near Moorhead

Loess kindchen are another item unique to the loess soils. Loess kindchen is actually calcium carbonate or "limestone" formations which look like small rocks. The geologists think they were formed when the limestone, which was carried by water, seeped down and attached itself to the roots of prairie plants. Because roots are odd shaped, the formations sometimes resemble human shapes. "Kindchen" is a German word meaning small people. The kindchen vary from microscopic to several inches in size. They are whitish, irregular, very hard and rock like.

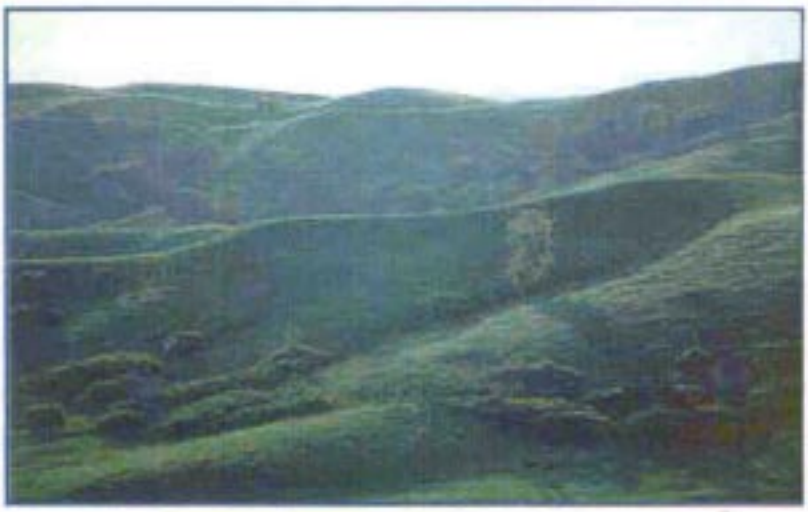
Ridges and cat-steps, near Moorhead

From a biological point of view, the value of the Loess Hills lies in the virgin prairie. If we look at prairies throughout the United States, we find the tall grass prairies in the east and the short grass prairies in the west. The Loess Hills are situated in the mixed grass prairie region. The Loess Hills contain not only the tall grass species such as switchgrass and big bluestem, but the shorter species such as buffalograss, blue grama, sideoats grama, and little bluestem. The largest concentration of mixed grass prairie in the United States lies within the Loess Hills. We have documented over 300 different species of plants that live in the Loess Hills.

There are several rare, endangered and unusual mammals, reptiles, amphibians and plants that are inhabitants of the Loess Hills. Two of the mammals include the grasshopper mouse and the plains pocket mouse, which is a member of the family of desert rodents in the southwest United States. Some of the reptiles include the thirteen line racerunner, the prairie rattlesnake, which is found in the Loess Hills in Plymouth County, the ornate box turtle which is usually found in dry, sandy soil types and is an inhabitant of this area.

In August, 1986, a large portion of the Loess Hills was designated as a National Natural Landmark by the National Park Service. The National Natural Landmark designation recognized the uniqueness of the area but did not provide any financial support to preserve or maintain any actual sites.

The Loess Hills are truly a unique, world class landform. The Indians often used the word "sacred" when describing the Loess Hills. To the Indians, "sacred" meant that an area was so special that no tribe or group of people could control it. Unfortunately, the



Broken Kettle Grasslands

white man does not have that perspective. Over 95% of the Hills are owned by private individuals. Our challenge is to impress not only the tourists, but also these private land-owners, with their beauty and uniqueness, as well as their value from a biological point of view.

Sorting It Out

Target Grades: K - 2

SUMMARY: Students make "soil globes" to learn the composition of different types of soil.

OBJECTIVE: Students will be able to describe the unique characteristics of Loess Hills soil.

GROUP SIZE: Any number

DURATION: One class period

KEY WORDS: loess, soil, silt, particles, mixture

STANDARDS: *Science Standards*
Properties of earth materials

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

MATERIALS: Two empty, clear plastic bottles or jars with lids, approximately 1 liter in size. Permanent markers, beads as large as possible, yet able to fit in the bottles (representing sand), medium sized sequins (representing loess), and very small beads (representing clay).

BACKGROUND INFORMATION: Soil is underfoot, and many times overlooked. Why is soil so special? We can't grow our crops without it, and we wouldn't have the Loess Hills without it either! Most soil is a mixture of different sized particles. One interesting thing about the Loess Hills is that they are made up of only one kind of particle, loess. Loess is a silt. That means it is a medium sized flat particle. (See chart to teach your students the different characteristics of soil composition.) The Loess Hills were formed by wind blowing this loess soil into big mounds. The only rocks found in the soil of the Loess Hills are kindchens, which formed after the hills did. (See "Kitchen Kindchens-Making a Kindchen" to learn more about kindchens.) Many of the Hills' geological features are due to the size and shape of the loess soil.

PROCEDURE:

1. Separate the beads, by size, into individual containers.

2. Next, tell your students you'll be making soil globes to demonstrate the concepts that soil particle size can affect the way that water moves through soil, and that the shape of soil particles might allow them to be blown by the wind to form hills.

3. In one bottle, place the large beads and relate how these are like sand (very large particles that help create air spaces in soil) . Now add the sequins, which are like the loess soil (they are medium sized and flat). Then, add the small beads to the jar. These small beads represent clay. Have the students notice how the small beads fill in gaps left by the other beads. (Real clay binds soil together.) Cap the bottle tightly, and turn the bottle over while asking your students to notice how the particles settle in the jar. Label this jar "soil mixture" with the permanent maker.

4. In the second bottle, put only sequins. Relate to your students that loess soils are all about the same size and are flat in shape. Cap the bottle tightly, and turn over the bottle asking the students to again observe how the particles settle. Label this bottle "loess soil" with the permanent marker. Discuss with your students the differences they observed between the two soil globes as the particles settled. Ask your students why the loess soil could be more easily carried by the wind. Have the students tell the role of clay in the first mixture, and see if they can transfer that information to the second situation, realizing that without clay, loess soil is very loose (nothing to bind it) and can easily be carried away by wind or water.

EVALUATION: Students will verbalize or draw pictures to show their understanding of the difference of the contents of the two bottles and how they relate to real soil.

EXTENSIONS:

1. Borrow the Area Education Agency's kit "Land of the Loess" to obtain real samples of loess soil to show your students.

2. Use a microscope to allow the students to view real samples of loess soil, and other types of soil.

3. Freeze water in a plastic bowl, and remove the ice to show in theory how a glacier could form loess soil, by having the "glacier" grind a path through some soil in your school playground area.

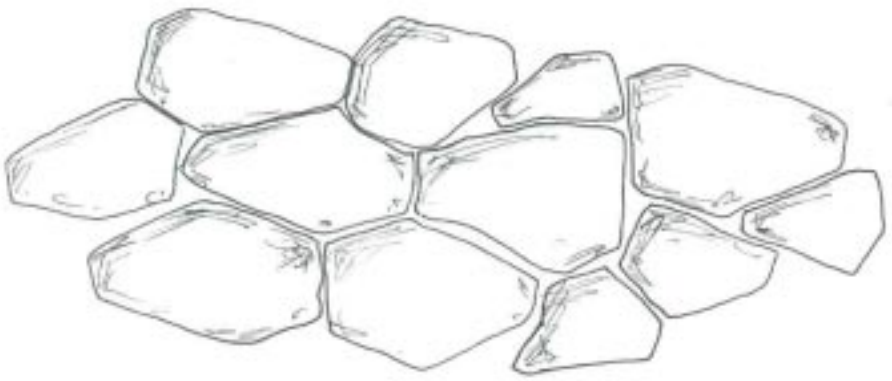
4. Make an edible mixture to enable your students to compare the relative sizes of soil particles. (This concept may be difficult for kindergarten students to understand, as they may not be able to transfer the information presented with food to actual soil unless you have soil samples to compare them with.)

EDIBLE MIXTURE MATERIALS:
Large bowl to mix ingredients
Paper cups (one for each student)
Jumbo marshmallows (representing sand)
Butterscotch disc hard candies (representing loess)
Skittles (representing clay)
or:
Puffed Cheese Balls (representing sand)
Chex cereal (representing loess)
M & M's candies (representing clay)

5. Make a bird food mixture to enable your students to compare the relative sizes of soil particles. (Again, the same caution that young students may not be able to transfer the knowledge from seeds to soil, unless soil samples are present also, and they can see the comparison.)

BIRD FOOD MATERIALS:
Large bowl to mix ingredients
Hazelnuts (representing sand)
Grey striped or black oil sunflower seeds (representing loess)
Millet, milo, or niger seed (representing clay)

RESOURCES: AEA kit "Land of the Loess" available through your local Area Education Agency.
Geology Rocks!, by Cindy Blobaum.



Microscopic Loess Hills Soil

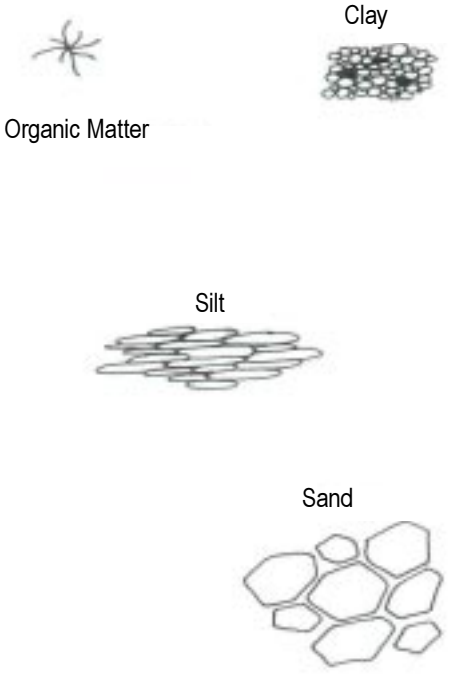
Background Information

Some “old timers” call loess soil “sugar clay” because of its color (it is lightly colored like clay), and because it dissolves and erodes easily in water (like sugar does). Many people mistakenly call the Loess Hills clay hills.

Soil Compositor

Organic Matter	*Clay*	*Silts*	*Sand*
add nutrients and texture to the soil	a very small particle that binds soil together. Clay and soil bind together into hard clumps, which are called “gumbo” and are found on the Missouri River floodplain.	loess and other silts are medium sized, flat particles. The Loess Hills are made of only loess soil.	very large particles that create air spaces in soil mixtures.

If you look at loess soil through a microscope, it looks a lot like amber-colored fish scales.



Kitchen Kindchens – Making a Kindchen

Target Grades: K -2

SUMMARY: Students learn about kindchens, a rock unique to the Loess Hills area, and make a "kindchen" using ingredients found in a kitchen.

OBJECTIVE: Students will be able to explain how kindchens are formed, and why they are found in the Loess Hills.

GROUP SIZE: Any number

DURATION: One class period

KEY WORDS: loess kindchen, calcium carbonate (lime), mineral, dissolved, concentrate

Kindchen

STANDARDS:

Science Standards
Properties of earth materials
Abilities to distinguish between natural objects and objects made by humans

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purpose (e.g., for learning, enjoyment, persuasion, and the exchange of information).

National Geography Standards
Understands the physical and human characteristics of place

MATERIALS: A picture of a kindchen, or a real kindchen (real kindchens are available in the AEA kit "Land of the Loess") recycled small plastic containers, such as a yogurt container, one for each student; smaller containers, such as film containers; flour (to represent loess); sugar (to represent calcium carbonate); sticks or twigs, one for each student; a two liter bottle of water; and a dish tub. If you want your students to take home their "kindchens", you may want to have a plastic baggie labeled "loess kindchen" for each student.

BACKGROUND INFORMATION:

Kindchens are hard nodules or rocks formed within the loess soil because the soil has the two qualities necessary for this formation to take place. First, it is loose with many air spaces, and second, it has the mineral, calcium carbonate (lime) in it. Kindchen is a German word meaning "little people". The base word, "kind" is the same as in kindergarten. The nodules are odd shaped, and were thought to resemble little people.

Kindchens can be pea-sized to squash-sized. The smaller ones are often thrown on sidewalks by children who enjoy watching the soft rocks explode, giving them the name "pop rocks". The larger ones, shaped like eggs, are often called (and often mistakenly believed to be) fossil dinosaur eggs, since they are white in color.

Kindchens are formed as water seeps through the soil, following air spaces and roots. The water carries dissolved calcium carbonate (the predominant mineral in limestone). The water evaporates and a concentrate of calcium carbonate is left behind in the loose soil, forming an irregularly shaped white rock.

PROCEDURE:

1. Gather the materials you'll need for the experiment. You will need 1/2 cup of flour and 1/4 cup of sugar for each student if you plan to have each student make their own kindchen.

2. Explain that kindchens are a special kind of rock because they form in soil that is loose (has air space), and that has the mineral calcium carbonate in it, like loess soil does.

3. Next explain that the students will be able to see how kindchens form by using kitchen ingredients to represent earth materials.

4. Have each student fill their plastic cup with 1/2 cup of flour. (You could sift the flour to make it even finer - explain that the flour is like the loess soil found in the Loess Hills.

5. Now, have each student add 1/4 cup of sugar to their container. Let the students use their sticks to mix the two together and compare the sugar to the mineral, calcium carbonate, that is found in loess soil.

6. Ask the students to poke the stick all the way into the "soil" mixture. Then, have them move the stick to one side to make a hole for water to run down.

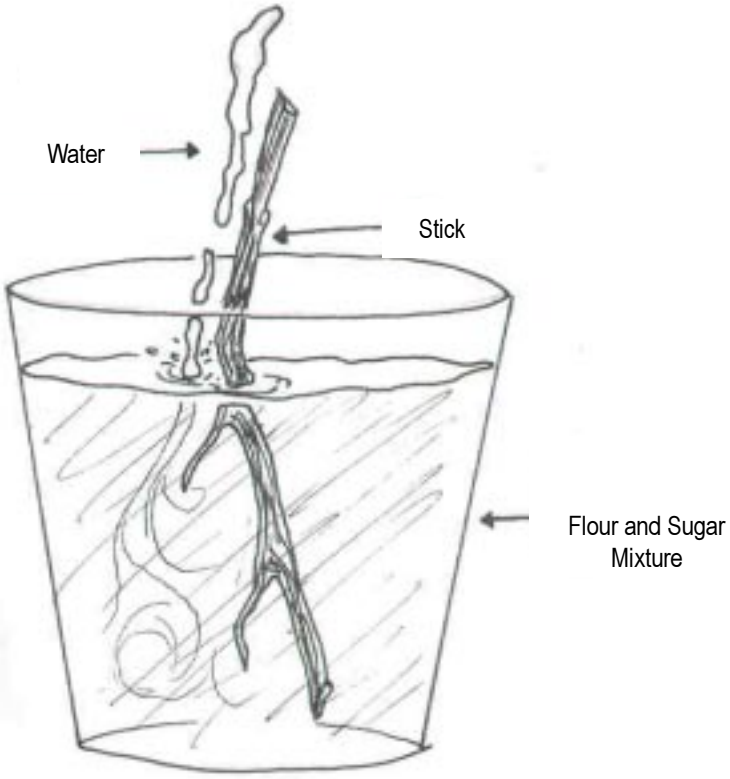
7. Using a film canister, each student should pour 1 canister full of water right on the twig so that it runs into the hole next to it. (The water will follow the airspace created by the "root" and dry to form a nodule very much like a kindchen.)

8. Let the container sit overnight. The next day, have each student dig out their "kindchen" carefully, as it will not be rock hard, but it will be odd shaped and crusted over on the outside. (Some of it may be stuck to the stick, this can be scraped off.)

9. Have the students examine their "kindchen " and discuss the following: In order for the kindchen to form it needed three things, 1). sugar/flour soil mix, 2). an air space and 3). water. In what ways were your homemade "kindchens" like real ones?

EVALUATION: Have the students tell their families how kindchens form, and why they are found in the Loess Hills. Students can bring a signed note from their families to show that they shared their "kindchens" and the process by which they were formed.

RESOURCES: Fragile Giants by Cornelia Mutel
Geology Rocks! by Cindy Blobaum
Igsb.uiow.edu/browse/loess/loess/htm - this site has pictures of kindchens, and other great Loess Hills pictures.



Web of Life

Target Grades: K - 2

SUMMARY: Using a ball of string and labeled cards of certain animals, students will be able to set up a "web of life".

OBJECTIVE: Students become aware of the significance of interrelationships of living things. "When one plucks at the web of life, one finds it attached to everything else."

GROUP SIZE: Any number

DURATION: 15 - 30 minutes

KEY WORDS: web, interdependence

STANDARDS: *Science Standards*
Organisms and environments

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their our purposes (e.g., for learning, enjoyment, and the exchange of information).

MATERIALS: Large ball of string
Labeled cards or pictures of each item
(Use cards provided in this lesson, and/or add your own.)

BACKGROUND INFORMATION: Though they may look like a simple "sea of grass", prairies are extraordinarily complex ecosystems. Some 300 species of plants, thousands of insect and spider species, scores of birds, dozens of mammals - to say nothing of the lichens, mosses, fungi and bacteria - make the prairie their home. This activity attempts to help students understand not the individual species, but rather the complexity of the "whole". All work together in this system, sometimes overlapping their functions, sometimes duplicating them. The web of prairie life is not fragile, rather it is flexible. If we remove too many strands, however, the web can be broken and fail.

PROCEDURE:

1. Assemble materials - a large ball of string and labeled cards or pictures of each item.

2. Place “soil”, “water”, “air’, and “sun” cards in a central location while indicating how these resources are necessary for life. Attach the “plant” card while stressing that plants are the basis for animal life.

3. Give one student a card such as “insect” and after discussing the interrelationship, run a string from “insect” to “plant” to indicate a direct relationship. Give out each animal card in turn to students, placing each person in the developing framework of strings. Use the “human” card last. This may be done in story form with the participation of students asking and answering questions.

4. Have each card holder in turn loosen his strings in the web and consider what relationships are upset by the elimination of each species. Stress the idea that no animal is all “good” or “bad”. Many other species may be affected by a change in population of any one species. Because humans are thinking animals, we have a special responsibility to the web of life .

5. Upon completion of the classroom demonstration of “web of life”, groups may be assigned to form their own particular “web of life . Various animals within different communities can be assigned to each student so that everyone is responsible for doing some research into the animals’ habits.

Note: Any number or kinds of animals may be used suitable to the age and experience of the students. See “Amazing Animals” for a list and pictures of specific Loess Hills animals.

EVALUATION: Students will be able to demonstrate some understanding of the inter-relationship of living things by directly participating in a small group, setting up a “web of life”. Each student must be able to explain the co-actions between one animal and other living things.

RESOURCES: Martin, A. (1951). American Wildlife and Plants, Dover, NY.
Zim, H.S. and D. H. . (1955). Mammals: A Guide to Familiar American Species Golden Press, NY.

CREDIT: This activity was adapted with permission from Project Bluestem, curriculum published by the Neal Smith National Wildlife Refuge and Prairie Learning Center.

WILDLIFE

PLANTS

SOIL

WATER

PEOPLE

INSECTS

SUN

AIR

Soil Builders

Target Grades: K - 2

SUMMARY: Students participate in a group "game" in which they act out the components of soil formation.

OBJECTIVE: Students will become aware of the many factors that contribute to the formation of soils.

GROUP SIZE: 15 - 30 students

DURATION: 45 minutes

KEY WORDS: soil, parent material, erosion, weathering, climate, topography, decomposition, leaching

STANDARDS: *Science Standards*
Characteristics of organisms
Organisms and environments

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

BACKGROUND INFORMATION: There are five basic factors that influence the formation of soils. They are parent material, climate, plant and animal life, topography of the land, and the length of time the processes have acted on soil material. These factors work so closely in combination that it is difficult to discuss the influence of one factor on a soil type without discussing the others. All soils have not been equally influenced by these factors, resulting in weakly developed, moderately developed, and well developed soils.

Parent Material: Parent materials are mineral and organic matter that accumulate in a particular area and provide the initial ingredients for the formation of soils. This material is sometimes already in a particular location, such as weathered bedrock, and other times is transported to an area by wind (such as the wind blown deposits of loess soil in the Loess Hills) or water. Some of these transported materials were carried to the place long ago by glaciers, which acted like giant bulldozers as they moved across the land. Ice scraped the surface of the earth, picking up and grinding huge boulders. Areas in the path of the glaciers were changed by deposits of gravel, sand, and rock that were left when the glaciers receded. Glaciers even influenced the formation of soils that were not in their paths. When the ice began to melt, sediments were carried by the water to other places.

Climate: Influences of climate include weathering and breaking down of parent materials into smaller particles by water and temperature. Freezing and thawing can crack and shift parent material. Water is often trapped in cracks and pores in the soil and parent material. When it freezes it expands, breaking down the material even more. Water moving through the soil and parent material causes changes by leaching, dissolving some of the minerals and washing them down through the soil.

Plant and Animal Life: Different types of plants have different influences on the formation of soils. Soils formed under prairie grasses have thicker, darker topsoil than the soils formed under trees. This is because when the prairie plants die, they decompose in and on the soil. Most of the decaying material in a forest is leaf litter which stays primarily on the surface, forming a thinner, lighter topsoil. In any case, plants add organic matter, decomposing plant material, that mixes with weathered parent material to form soil. Plants also help in soil formation by altering the structure of soil and parent material with the forceful growth of their roots. Growing roots have been known to fracture boulders if they begin growing in cracks.

Animals such as earthworms, crayfish, mice, and voles allow air and water to move in by digging through the soil. They also mix the soil, bringing the organic matter down from the surface to decompose and enrich the soil and minerals up to the vicinity of plant roots. This also enriches the soil, providing plants with valuable nutrients.

Topography. The amount of slope or "hilliness" of the land influences the formation of soil because it affects the amount of moisture and erosion. The bottoms of hills tend to be wetter and accumulate eroding soil from the tops of hills. Hill tops tend to be drier and more freely drained. These areas have a tendency to erode, especially in cases where the soil is exposed through tillage, overgrazing, or construction.

Time: How long a parent material has been present and how long soil forming factors have had to work greatly influences the degree of soil formation. Soils with recent decomposition of parent material, as with flooding, tend to be less developed than soils with parent material deposited by glaciers.

PROCEDURE:

1. Students are assigned the following roles and actions, trying them out individually.

Roles:

a. *Parent Material* - lie on the floor, murmuring "gonna be soil , gonna be soil"
b. *Lichens* - sit on or near parent material, emitting "fweet" sounds through teeth (lichens give off a weak acid, which works to break down parent material).
c. *Wind* - run around parent material, "blowing"
d. *Rain* - run around parent material "raining" with hands, making dripping sound effects.
e. *Glacier* - slowly walk or roll around saying "scrape, scrape".
f. *Water* - (at least two people) one "freezes", clasping hands around body and shivering, and then "thaws", pretending to heat up and become liquid; one leaches, traveling around the parent material (in a watery manner) slurping minerals away.
g. *Plants, Roots* - kneel, hands move above heads, legs stretch out, stand up, "grow" and die.
h. *Prairie Deer Mouse or Vole* - digging motion, murmuring "dig and mix, dig and mix".
i. *Earthworms* - squirm around, saying "in comes the old plants, out goes the good soil".
j. *Bacteria and Fungi* - crouch and whisper "rot, rot, rot".

2. The number of students per role will depend on the number in the class and may be assigned at the teacher's discretion. As each is assigned, make certain that they understand what each function/role is.

3. When all roles have been assigned and practiced, they are put together and acted out simultaneously.

4. Bring closure by reviewing the five basic factors of soil formation, asking which of these factors each "role" represented.

EVALUATION: Students illustrate their concepts of how soil is formed, incorporating factors from the activity, either individually in journals, or as a group mural.

EXTENSIONS:

1. Students may wish to further research their specific roles or add new ones as they learn more about soil.
2. Invite a representative from the Soil Conservation Service to come and visit your school to talk about the soils of your area.
3. Take core samples of soil at your school and at other areas in your community. Allow the students to examine them, and compare the composition.
4. Serve "Dirt Cake" a recipe from the National Soil Tilth Laboratory, 2150 Pammel Drive, Ames, IA 50011:

DIRT CAKE

Ingredients:

1 medium flower pot
1 cup powdered sugar
1 pkg of choc. sandwich cookies
2 - 3 oz. boxes of instant choc. pudding
1- 12 oz. tub of whipped topping
1 package of candy gummy worms
2 cups milk
8 oz. cream cheese

Instructions:

Crush the cookies and set aside. Mix powdered sugar and the cream cheese; set aside. Mix the instant chocolate pudding and milk and then blend with the whipped topping. In the flower pot, layer the three mixtures, saving some cookie mix for topping. Place the gummy worms into the crushed cookies on top (topsoil). Chill and serve later with a trowel or sand shovel.

RESOURCES: Weber, Eldon C. Earthworm Empire: The Living Soil (1996). Dubuque, IA: Kendall Hunt Publishing Company.

CREDIT: This activity was adapted with permission from Project Bluestem, curriculum published by the Neal Smith National Wildlife Refuge and Prairie Learning Center.

Butterfly Buffet

Target Grades: K – 2

SUMMARY: Students role play the part of a host plant, caterpillar or butterfly to discover their interdependence.

OBJECTIVES: The students will identify some of the native Loess Hills plants that provide food for insects. Students will recognize the interdependence of plants and insects.

GROUP SIZE: 20 - 30 students

DURATION: One class period to color and prepare materials
One class period to teach background information
One class period spent role playing
One class period if hands-on assessment is used

KEY WORDS: host plants, interdependence, habitat, Loess Hills, nectar plants, chrysalis, pupa, metamorphosis, and land formation

STANDARDS: *Science Standards*
Characteristics of organism
Life cycles of organisms
Organisms and environments

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

BACKGROUND INFORMATION: There are many interesting butterflies and moths to be seen in the Loess Hills. One is the Ottoe skipper, which lays her eggs on prairie grasses because the caterpillars must feed on prairie species. Another is the regal fritillary. This butterfly is totally restricted to virgin prairie because its caterpillars depend on only a few species of prairie violets. The regal fritillary can often be found in Harrison and Monona Counties.

The yucca moth is another interesting insect common in the Loess Hills. The yucca moth is the only insect which can pollinate the yucca plant, and the yucca plant is the only host for the yucca moth eggs. When the larvae hatch, they eat the yucca seeds until they are mature enough to leave the seed pod.

The milkweed plant is the host plant (a host plant is one the insects uses to lay its eggs on and the emerging larvae use to feed on) to the caterpillar of the monarch butterfly.

A common flower seen in the Loess Hills is the pale purple coneflower. (coneflower was used by Native Americans and settlers for snake bites, bee stings, headaches, stomach cramps and toothaches.) Many butterflies, including the giant swallowtail and the monarch, are attracted to the purple coneflower. The giant swallowtail only lays eggs on trees that are members of the citrus family. Prickly ash is a citrus family tree that provides food for the caterpillar of the giant swallowtail.

Luna and cecropia moths are also found in the Loess Hills. The larva of the cecropia feeds on a variety of trees and shrubs such as cherry, plum, elderberry, apple, box-elder, maple, walnut, birch, and willow.

Butterflies:

Butterflies have four life stages. The adults mate and the female lays eggs, which hatch into tiny caterpillars or larvae. These, feeding on particular kinds of host plants, grow and shed their skins to accommodate that growth. Finally, the caterpillar enters the pupa or chrysalis stage. During this time, in the chrysalis, the larval material rearranges itself to become the adult butterfly. When it is ready, the butterfly emerges, spreads and dries it wings, and begins the cycle once more. (The process of development through several different stages is called metamorphosis.)

The bodies of butterflies, like those of all insects, have three main parts. They are: (1) the head, (2) the thorax, and (3) the abdomen. Every butterfly has four wings. The wings may be held in an open or closed position. The colors on the wings come from scales. (These are tiny shingles that cover both butterflies and moths, setting them apart from all other insects.) The patterns on the wings serve many functions such as camouflage and attracting mates, and may vary from place to place and often differ between sexes.

Hesperia ottoe male

Moths: Like butterflies, moths change form as they develop into adults. They undergo the same series of changes that butterflies do in their life cycle. They have the same three main body parts that butterflies do. Moths differ from butterflies in a number of important ways. For example, most moths fly at dusk or at night. The majority of butterflies fly during the day. For most moths, the hind wing is attached to the front wing by a hook or a set of hooks, called a frenulum. Butterflies lack a frenulum. In addition, most butterflies have antennae that widen at the end and resemble clubs. The antennae of most moths are not club shaped, they are featherlike.

PROCEDURE:

1. Copy plant, caterpillar and butterfly cards in quantities needed. (designated colored paper optional)

2. Have students color the cards. Then, attach each card to a long strip of construction paper to make a head band for each child. Staple to fit around each child's head. (An alternative procedure would be to hang the plant cards around the room rather than having students take the roles.)

3. Cut up strips of yellow paper to use as "nectar" for the butterflies and moths to collect.

4. Students are assigned the role of a specific Loess Hills flowering plant, caterpillar, or host plant: 8 plants, 3 moths, 4 butterflies, with the rest of the students taking the role of caterpillars.

5. Put names of students who are caterpillars in a container to draw out when an event is read.

6. Wearing designated headbands, plants are scattered about the room. Caterpillars seek out host plants to eat. Teacher or a designated student reads events in order listed for plants and caterpillars (alternating lists). As caterpillars emerge as butterflies or moths, they seek out flowering plants for nectar. Butterflies and moths may go to any and all of the flowers for nectar. Plants, caterpillars, and butterflies that meet their demise in some way or go through metamorphosis, sit down and remove their headbands.

EVALUATION: Students could match picture cards of butterflies and moths to pictures of host plants to show their understanding of the interdependence of plants and insects. Students could act out or draw the life cycle of butterflies and moths to show their understanding of the series of changes that are part of the metamorphosis of the two insects. Students could make a "life cycle" of a butterfly out of macaroni, correctly sequencing the events to show understanding.

EXTENSIONS:

1. Make a bulletin board with plant, butterfly, moth and caterpillar pictures. Have students connect yarn to match host plants with their insect or larvae.

2. Plant a butterfly garden at your school. Research the plants you'll need to purchase and then contact local stores for possible donations. Look for small grants available to help with your project.

3. Look up "Journey North" on the internet to follow butterfly migrations

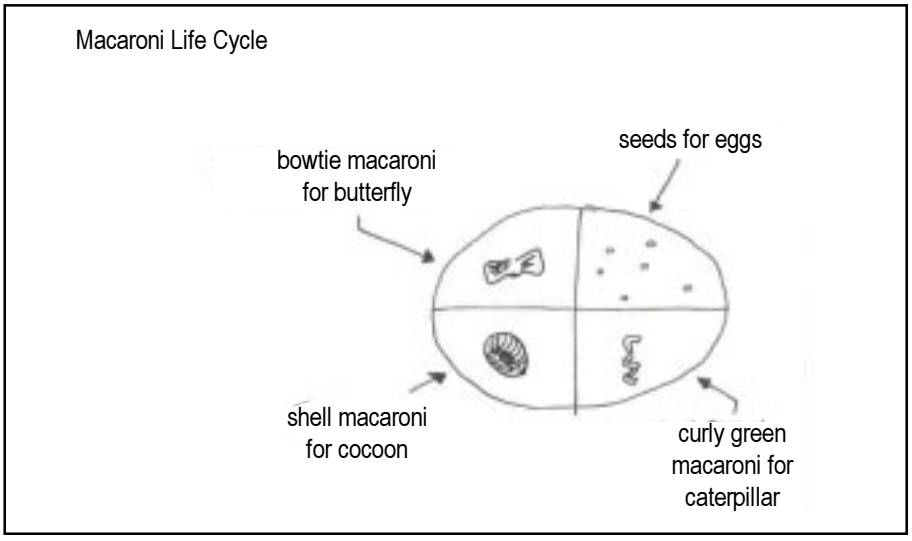
RESOURCES: Arnosky, Jim. Crinkleroot's Guide to Knowing Butterflies and Moths.

Audubon Society. The Audubon Society of North American Butterflies Field Guide.

Biggons, Gail. Monarch Butterfly.

Christiansen, Paul & Mark Múller. An Illustrated Guide to Iowa Prairie Plants.

Iowa Association of Naturalists. Iowa Biological Communities. Iowa Prairies.



Mitchell, Robert & Herbert Zim. A Golden Guide to Butterflies and Moths.

Mora, Raul Mina. Backyard Trees.

Sammis, Kathy. The Beginning Knowledge Book of Butterflies.

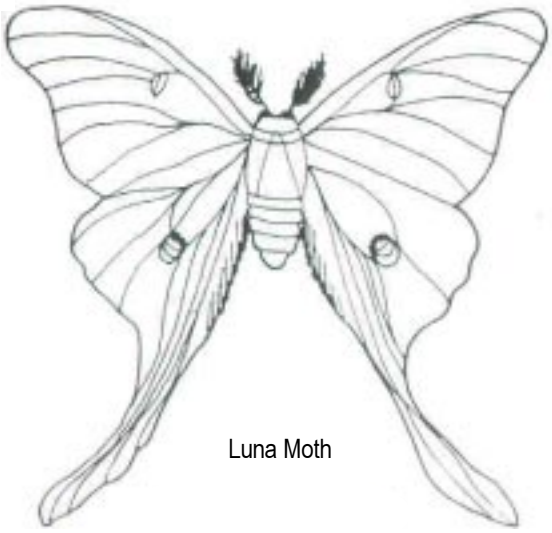
Stokes, Donald & Lillian. The Butterfly Book - An Easy Guide to Butterfly Gardening, Identification and Behavior.

Tekulsky, Mathew. The Butterfly Garden.

Whalley, Paul. Butterfly and Moth - Eyewitness Books.

INTERNET SITES: http://www.loesshills.com/
http://www.teachers.net/lessons/posts/1023.html
learner.org/jnorth > Journey North

Cecropia Moth



Luna Moth

Monarch Butterfly

Giant Swallowtail Butterfly

Regal Fritillar Butterfly

Plant Events

Rain shower. You grow big and healthy. (all)

_____

Hail storm. Your leaves are cut to shreds. (pull a plant student name)

_____

You are cut down by a lawn mower. (pull a plant student name)

_____

No rain. You wither and die. (pull a plant student name)

_____

Lots of sunshine. You produce lots of beautiful flowers. (pull a plant student name)

_____

Your beautiful flowers are picked by a hiker. (pull a plant student name)

_____

You are run over by a motorcycle and crushed. (pull a plant student name)

_____

You are cut down by a weed whacker. (pull a plant student name)

_____

You are killed by lawn and garden sprays. (pull a plant student name)

_____

Rain shower. You grow big and healthy. (any remaining plants)

_____

Plants that die, remove head band and sit down.

Note: You may not wish to use too many of the ones that kill off the plants before butterflies and moths emerge. However, playing the game several times will allow students to see how these events might impact the survival of the caterpillars, moths, and butterflies.

You may also want to have extra plants hung around the room.

Caterpillar Events

You eat and eat.

_____

You grow big and fat.

_____

You are eaten by a bird
(pull a student caterpillar name)

_____

You are run over by a bicycle
(pull a student caterpillar name)

_____

You form a chrysalis (caterpillars of the ottoe skipper, regal fritillary, monarch, giant swallowtail butterflies)

_____

You spin a cocoon (caterpillars of the cecropia, luna and yucca moths)

_____

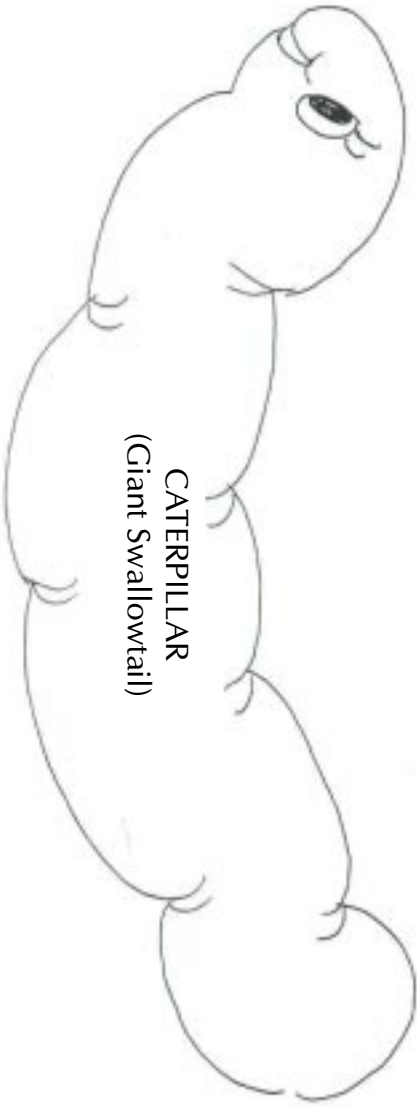
Butterflies change into a beautiful butterfly through the process called metamorphosis

_____

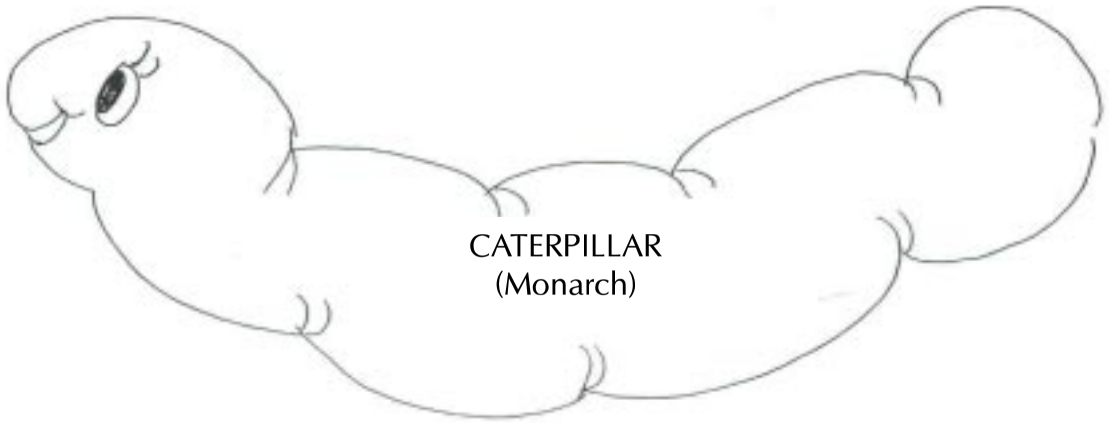
Moths emerge from your cocoon, a beautiful moth

_____

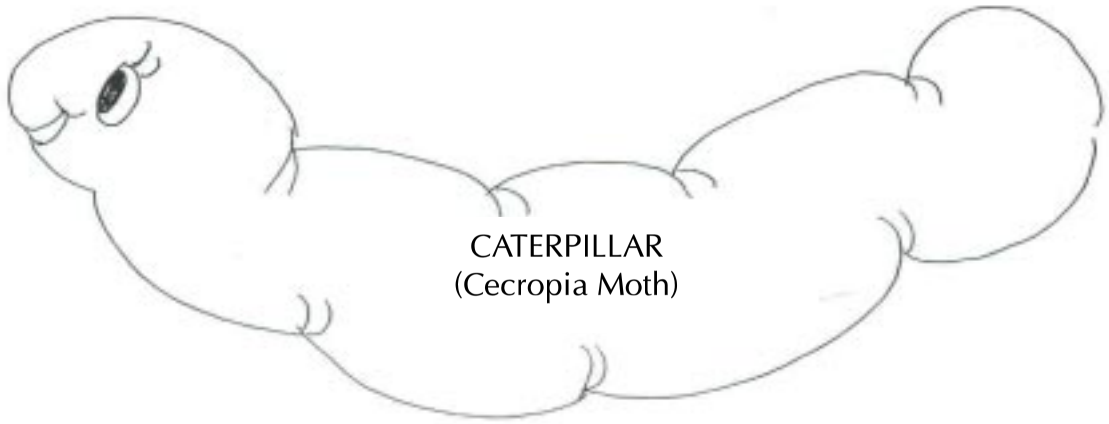
(Caterpillars remove head bands and sit down. Their life phase is over.)



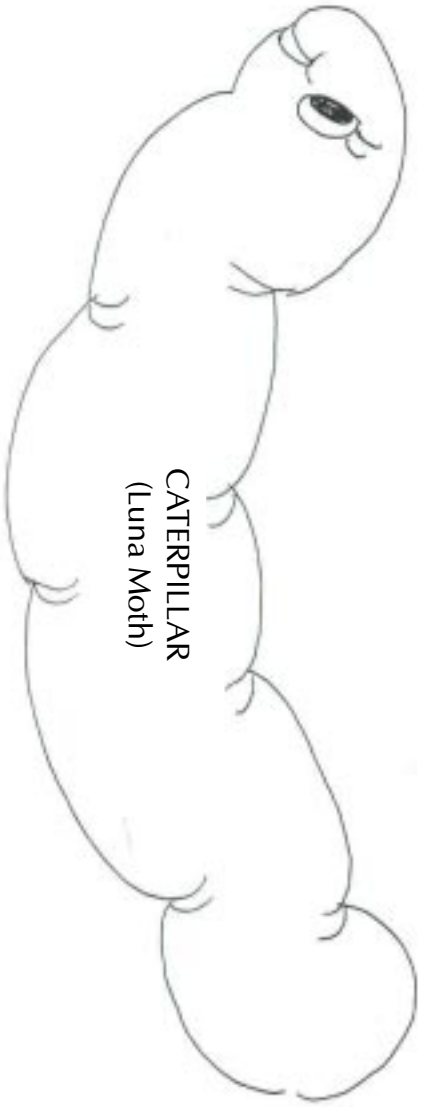
CATERPILLAR
(Giant Swallowtail)



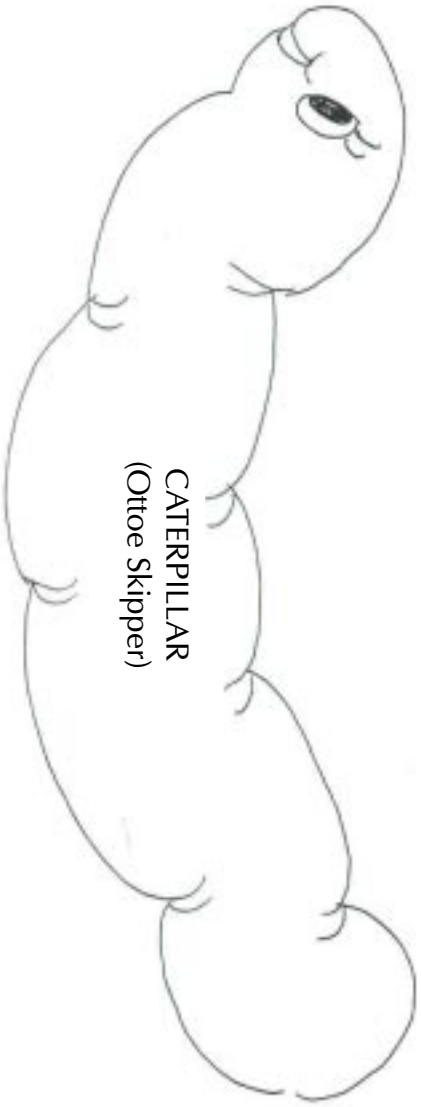
CATERPILLAR
(Monarch)



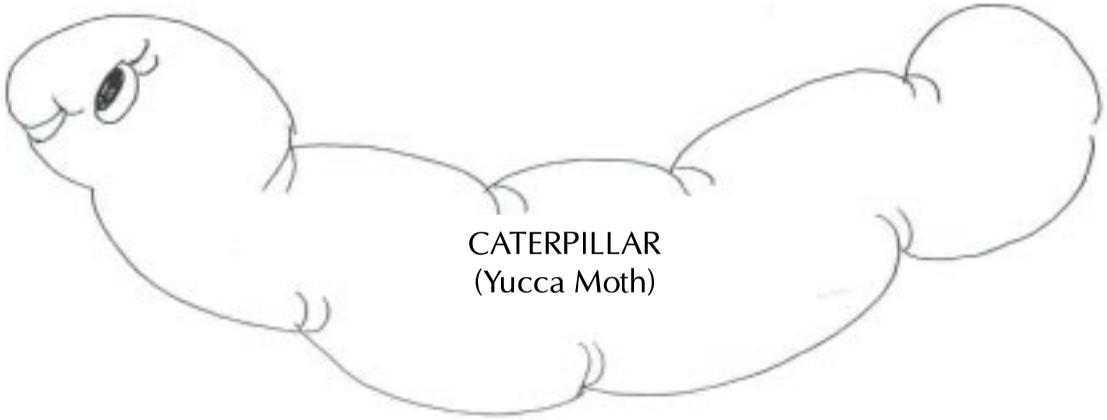
CATERPILLAR
(Cecropia Moth)



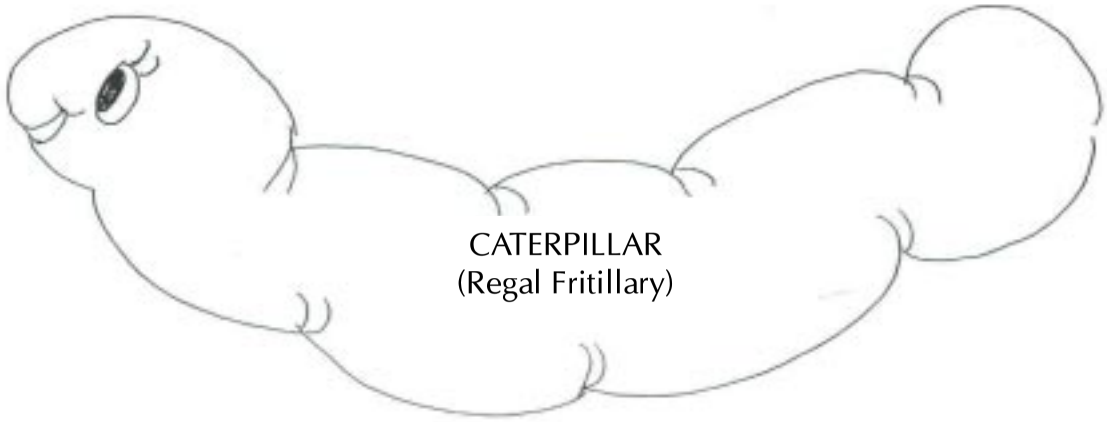
CATERPILLAR
(Luna Moth)



CATERPILLAR
(Ottoe Skipper)



CATERPILLAR
(Yucca Moth)



CATERPILLAR
(Regal Fritillary)

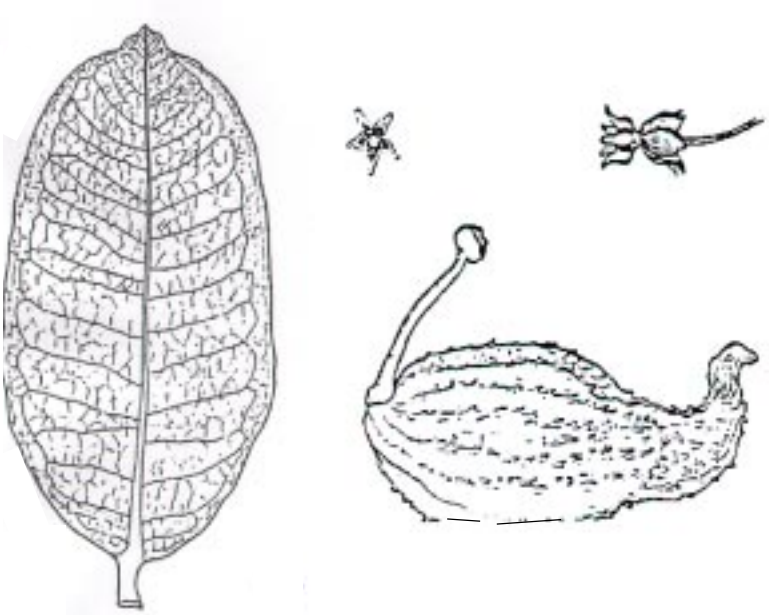
Butterfly Events	Moth Events
You gather nectar from flowers. (all flutter about and pick up nectar, yellow strips of paper, from flowers) _____	You gather nectar from flowers. (all flutter about and pick up nectar, yellow strips of paper, from flowers) _____
A bird eats you. (pull a butterfly student name) _____	A bat eats you (pull a moth student name) _____
Ottoe skipper lays eggs on switch grass. _____	Yucca moth lays eggs on the yucca plant. _____
Regal fritillary lays eggs on prairie violets. _____	Cecropia moth lays eggs on willow tree. _____
Monarch lays eggs on milkweed plant. _____	Luna moth lays eggs on the walnut tree. _____
Giant swallowtail lays eggs on prickly ash tree. _____	You are hit by a car. (pull a moth student name) _____
Monarch migrates south for the winter. _____	A cat catches you to play with, you die (pull a moth student name) _____
You are killed by a hailstorm. (pull a butterfly student name) _____	Winter comes, you freeze to death. (all surviving moths)
You are caught in a butterfly net and put in a jar. (pull a butterfly student name) _____	
Winter comes, you freeze to death. (all surviving butterflies) _____	

ASCLEPIADACEAE
Milkweed Family

Common milkweed
Asclepias syriaca L.

Stem: perennial, 2′ to 3′ tall; unbranched; hairy; with milky juice in the stem and leaves.
Leaves: opposite; oval with rounded base and tip; 4 1/2″ by 2 1/2″; hairy above and below; leaf stalk 1/4″ to 1/2″.
Inflorescence: many-flowered umbels (up to 100 flowers) from the stem tip and upper leaf axils; on hairy stalks.
Flowers: pink, fragrant flowers, petals 1/4″ long and reflexed, hoods 1/4″ tall with protruding horns; flowering from late June to late July.
Fruits: seedpod is a follicle; 4″ long by 1″ in diameter, tapering to a curved tip; surface warty and covered with fine hairs; seeds 1/4″ by 1/8″, flat, brown with a tuft of white hairs at one end; fruiting begins in late July, and seed release begins about mid-September.
Habitat: frequent in moist to mesic open places with some disturbance; not common on prairies.


A. syriaca


A. syriaca

ANGIOSPERMS:
MONOCOTYLEDONS

AGAVACEAE
Yucca Family

Soapweed
Yucca
Yucca glauca Nutt. ex Fraser

Stem: perennial, basal leaves and a tall flower stalk to 5′ tall.
Leaves: basal; numerous; linear, gradually tapering to a spine-tip; 1′ to 2′ by 1/2″; threads on the margins; smooth above and below.
Inflorescence: raceme at the tip of the flower stalk; raceme 6″ to 2′ long; each flower attached to the flower stalk above a bract, 1″ long, lance-shaped.
Flowers: petals and sepals white, large (1 1/2″ long), forming a cup-shaped flower; on a curved stalk, the flower facing downward; flowering from early to mid-June.
Fruits: capsule, 1 1/2″ to 2″ long by 1″ in diameter, held upright; three-chambered with many flat, black seeds, fruiting begins in late June.
Habitat: frequent on west- and south-facing Loess Hills prairies in the western tier of counties in Iowa.

Soapweed is pollinated by night-flying moths who use the ovary of the flower as the site to lay their eggs. The young larvae eat the developing seeds.

PALE CONEFLOWER
Echinacea pallida Nutt.

Stem: perennial, basal leaves with a 2′ to 3′ flower stalk; few, long hairs.

Leaves: mostly basal; elongate-oval, blades 7″ by 3/4″ with leaf stalks from 6″ for basal leaves to 3/4″ for stem leaves; parallel veins in the blades; bulb-based hairs above and below.

Inflorescence: single head at the top of a stalk having stiff hairs and few, small leaves.

Heads: purple, drooping rays, 1 1/2″ long, dark purple disk flowers on a conical base, the disk about 1″ tall and 1″ in diameter; flowering from mid-June to mid-July; rays often persist until August.

Fruits: "seeds" (fruits) about 1/8″ long, squarish and pointed at one end; no plume; fruiting begins in late June; often fruits persist in the head through the winter.

Habitat: infrequent on dry to mesic prairies; sometimes on little-disturbed roadsides and in open places.

VIOLACEAE
Violet Family

Prairie violet
Viola pedatifida G. Don

Stem: perennial, very short with basal leaves.
Leaves: basal; deeply lobed into linear segments, each segment again lobed; blades 1 1/4″ by 1 1/2″ and larger; leaf stalks 1″ to 4″ long, smooth; hairs on the margins and veins.
Inflorescence: flowers solitary on smooth flower stalks from the base of plant; open flowers on flower stalks slightly above the leaves; nonopening flowers on shorter flower stalks.
Flowers: petals violet, about 3/8″ to 3/4″ long, with hairs near the base of the lower three petals; sepals 1/4″ long; base of flower curved backward under flower stalk forming a spur containing nectar-producing glands; flowering from early to late May.
Fruits: capsule, 7/16″ long, opening into three segments; open flowers seldom producing seeds; nonopening flowers on the short stalks below the leaves setting fruit through self-pollination; fruiting begins in late May.
Habitat: frequent on mesic to dry prairies; also on moist prairies.

What's All the Fuss About Loess?

Target Grades: K - 2

SUMMARY: Students will gain an understanding and appreciation of the Loess Hills by comparing them to similar geographic or human made features they are familiar with. Students will brainstorm reasons why high places such as the Loess Hills are important, and make a mural depicting those reasons.

OBJECTIVE: Students will realize that high places like the Loess Hills can have a special significance to people for aesthetic, religious, ceremonial, social, scientific, cultural, educational, and ecological reasons.

GROUP SIZE: Any Size

DURATION: One class period for background information and discussion
One class period for creation of mural

KEY WORDS: loess (rhymes with fuss), aesthetic, religious, ceremonial, social, scientific, cultural, educational, and ecological

STANDARDS:

Science Standards
Changes in earth and sky
Ability to distinguish between natural objects and objects made by humans

National Geography Standards
Understands the physical and human characteristics of place
Understands that culture and experience influence people's perceptions of place and regions

National Art Standards
Understands characteristics of works in various art forms that share similar subject matter

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

MATERIAL: Pictures of the Loess Hills from such sources as internet sites, the AEA trunk "Loess Hills", and Mutel and Swander's Land of the Fragile Giants. Pictures of mountains, tall buildings, mural paper, crayons and markers. (For a literature tie-in, Tomie De Paola's The Legend of the Indian Paintbrush in which a Native American boy goes to the top of a mountain to gain a vision for how to help his tribe.)

BACKGROUND INFORMATION: The Loess Hills are a special place in Iowa, just as the rainforests and other places that we hear about that are far away are special to those who live there. They are unique in the type (loess) and depth of soil (over 200 ft deep deposits), the way they were formed by wind and water, the dry desert-like ridge tops, the native prairies, the woodlands, the animals, and plants. High places have always been special to our culture, as well as to many others.

Dr. Thomas Rosburg, a Drake University biologist, captures the feeling in this reflection from Land of the Fragile Giants:

"A climb to the top of a loess ridge... injects a healthy dose of inspiration into one's imagination. I have climbed and dawdled on high loess ridges in all nine Loess Hills counties, seven in Iowa, and two in Missouri, and every time as I gaze across the unending drifts of loess, I prod my imagination for a glimpse of the past. What were the Hills like before Euro-Americans arrived? What animals and plants should be here?"

PROCEDURE:

1. Gather all the pictures. Review the introduction to this lesson and prepare your class to think about all of the ways that high places, like hills, have been important to people.

2. On your mural paper, have students draw long wavy lines to represent the hills, and label the mural " The Loess Hills of Iowa".

3. Open the discussion either by reading the Tomie DePaola book, The Legend of the Indian Paintbrush (in which a Native American boy goes to the top of a hill to gain a vision for how to help his tribe) or by asking your students about their experiences climbing up to high places, such as a tall hill. Was it fun? Was it special? Perhaps some of them have been to mountains on vacation, or climbed a fire tower, or perhaps your school is located in or near the Loess Hills and your students have climbed to the top of a loess ridge.

4. Next, ask your students to brainstorm as many reasons as they can about why high places might have been important to Native American people (look outs, spotting game, camping above flood lines, burial grounds, meditation, meeting places, etc.).

5. As the students give ideas, write them down on pieces of paper and place them on the mural.

6. Now, have them brainstorm as many reasons as they can that high places might be important to them (adventure; scenic beauty; fun; recreational uses such as camping, hiking, sledding, skiing; places to farm; to build a home; cemeteries; and inspiration).

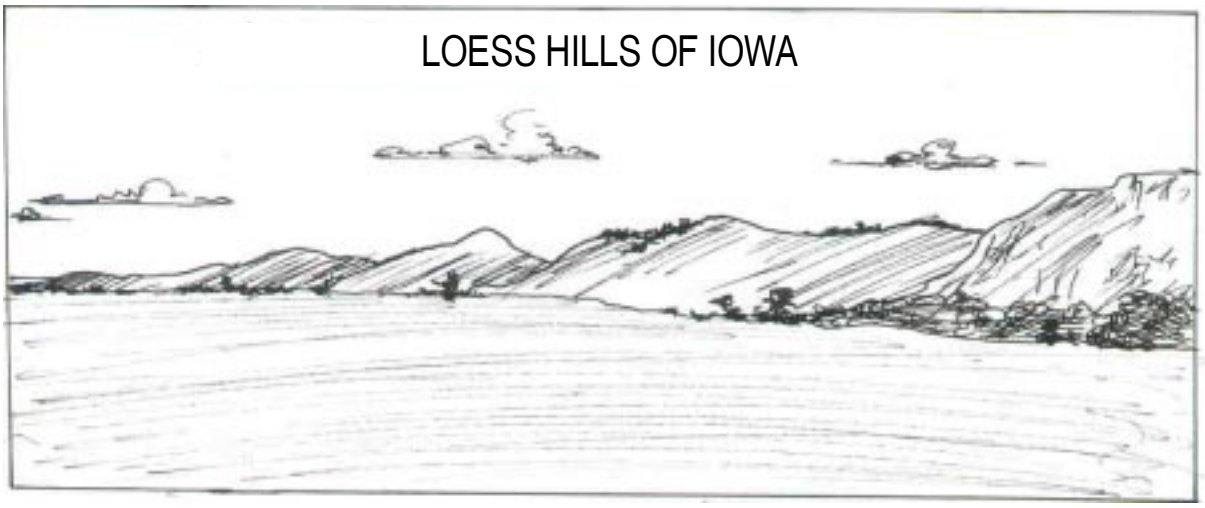
7. Again, as the students offer their ideas, write them down on paper and attach to the mural.

8. Next, ask the students to see if any of the reasons are similar in nature. Explain the vocabulary words: aesthetic, religious, ceremonial, social, scientific, cultural, educational and ecological to your students. They should be able to see that there are many reasons that high places are special, and that that feeling is shared by more than one culture.

EVALUATION: Students will illustrate their mural of the Loess Hills with drawings which show they understand the various reasons the hills are special. They could also create dioramas by folding paper and illustrating their own personal reason for valuing the Loess Hills. (See The Big Book of Books by Dina Zikes for instructions.)

EXTENSIONS:

1. Visit the Loess Hills or a hill near your school. Have your students take pictures or draw pictures in journals while you are there.
2. Have your students write stories about going to special high places.



Attach reasons and draw pictures to illustrate your Loess Hills mural.

Lewis and Clark's Keelboat

Target Grades: K - 2

SUMMARY: Students will construct a model of Lewis and Clark's keelboat after being introduced to the role their expedition played in the discovery of plants and animals in the Loess Hills and in the history of the United States.

OBJECTIVES: Students will be able to explain the importance of Lewis and Clark's expedition to the Loess Hills area. Students will be able to describe the functions of and construct a model of a keelboat similar to that used by Lewis and Clark on their expedition.

GROUP SIZE: 20 - 30 students

DURATION: One to three class periods for background information
One to two class periods for keelboat construction

KEY WORDS: keelboat, Lewis and Clark's expedition, poles, mast, rudder, Missouri River, Loess Hills

STANDARDS:

Science Standards
Understanding about scientific inquiry
Abilities to distinguish between natural objects and objects made by humans

National History Standards
Students should develop an understanding of the characteristics of societies in the Americas

National Geography Standards
Understands the physical and human characteristics of place
Understands how human actions modify the physical environment
Understands that culture and experience influence people's perceptions of places and regions

National Art Standards
Understands characteristics of works in various art forms that share similar subject matter, historical periods, or cultural context

MATERIALS: Lewis and Clark resources (books, pictures, videos, keelboat reproduction at Blue Lake, etc.) small boxes, one per student, for boat frame (shoe, cereal, cheese, or pop flat) gelatin box, or similar small box, one per student, to use for quarters on boats, bark pieces or leaves to cover the outside of the box (boat), twigs to use for foot holdings, poles and mast, 6" x 6" inch paper toweling or fabric, one per student, for mast, craft glue, empty thread spools, scrap material for individual designs

BACKGROUND INFORMATION: The Lewis and Clark expedition was an important event in the history and expansion of the United States. Lewis and Clark's journals of the expedition describe the natural resources and native people along the Missouri River / Loess Hills region and the western United States and contain information on many scientific matters.

On May 14, 1804, the expedition set out in a keelboat and two pirogues (dugout canoes). The men moved the keelboat by pushing poles against the river bottom or by pulling the boat with ropes from the shore. The keelboat carried a large amount of supplies, including food, medicine, scientific equipment, weapons and presents for the Native Americans.

While Lewis and Clark were unable to find an east-west water route for travel across the United States, their scientific discoveries of plant and animal species, geological sites, and the contacts and trade they established with Native Americans along the way were historic. Their journals were first published in an edited version in 1814, and in their entirety in 1905.

Keelboat: a large raft-like barge used to haul freight and passengers. A keelboat was a long narrow craft, sharp at one or both ends. It was built on a keel and ribs. The boats were moved by the current, by the long oars which were also used for steering, and if necessary, by pulling ropes from the shore.

PROCEDURE:

1. Assemble a variety of resources on Lewis and Clark's expedition.

2. Decide if you'll want to introduce the lesson with a video, oral reading of excerpts from the journals of Lewis and Clark, or student discovery, allowing them time to examine the resources and share their findings.

3. Introduce your students to the relevance of the land and water at the base of the Loess Hills and have your students hypothesize how the two explorers were able to travel through this area to study the biology, geology, and peoples of the area.

4. Then, pick specific journal entries that describe the use of the keelboat by the expedition. An excellent source for this is The Journals of the Lewis and Clark Expedition edited by Gary Mouton and published by the University of Nebraska Press.

5. Have students research keelboats if possible. Two excellent internet sites are:
   < hftp://www.keelboat.com>
   <hftp://keelboats.freeservers.com>

6. After researching keelboats, students can demonstrate their knowledge of the boat's design and purpose by constructing a boat out of found natural and manmade items.

   A suggested design might include:
   - gluing bark or leaves on exterior of box with craft glue
   - gluing gelatin box near front of boat, and cover with bark or leaves
   - gluing spool behind the gelatin box "quarters", and insert a twig for a mast
   - making holes in the top and bottom of the mast to insert the twig
   - gluing twig "footholds" in the floor of the boat
   - setting in poles

EVALUATION: Students can be graded on the successful completion of their keelboats. Students could also, as a group or an individual project, write or draw pictures showing what the journey on the keelboat would have been like for Lewis and Clark and their expedition members.

EXTENSIONS:

1. Arrange a field trip to see the keelboat at Blue Lake, near Onawa, IA.
2. Have students design postcards or posters showing Lewis and Clark's expedition using the keelboat in the Loess Hills area.

RESOURCES:

Ambrose, Stephen E. Undaunted Courage.
Blumbers, Rhoda. The Incredible Journey of Lewis and Clark
Koll, Steven The Incredible Journey of Lewis and Clark
Moulton, Gary E. The Journals of the Lewis and Clark Expedition
Lewis and Clark State Park, Onawa, IA, @ (712) 423-2829

Silty Soil

Target Grades: 3 - 5

SUMMARY: Students will investigate components of soil by comparing soil to flour, baking soda, cornmeal and cornstarch.

OBJECTIVES: Students will be able to list the components of soil and describe their texture.
Students will be able to describe the major component of loess soil.
Students will be able to infer what the relationship is between high erosion rates and the lack of clay particles in loess soil.
Students will be able to understand the relationship of plant cover to erosion rates.

GROUP SIZE: Any number

DURATION: Part One, 45 minutes
Part Two, 45 minutes plus time to collect soil samples

KEY WORDS: arid, erosion, loess, silt, soil

STANDARDS: *Science Standards*
Abilities necessary to do scientific inquiry
Properties of earth materials

MATERIALS: Part One, basketball, softball, marble, cornmeal, cornstarch, baking soda, and water
Part Two, quart jars, newspapers, soil, water and alum

BACKGROUND INFORMATION: Soil is essential to many forms of life. It is the foothold for the food, fiber and feed crops we grow. In many places, it provides support for our buildings and roads. It cleanses and holds water. It absorbs heat from the sun and radiates this heat at night.

Soil forms a thin mantle over much of the land surface of the earth. It is produced from the action of climate and living matter acting upon the rocks. Every soil contains soil materials, organic matter, living organisms, water and air in various amounts.

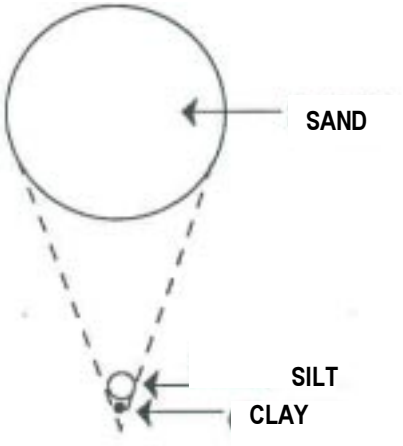
Soils are made up of three different sizes of particles: sand, silt, and clays. The relative size of these particles can be compared to common items. Sand would be equivalent to a basketball, silt would be the size of a baseball, and clay sized particles would be like marbles. The USDA Soil Conservation Service's definition of soil materials labels sand as: (.05 -2 mm), silt as (.002 -.05 mm), and clay as (less than .002 mm).

The loess soils are composed primarily of silt-sized particles. The wind-deposited silt originated during the Pleistocene period of geologic time in river valleys that were clogged with debris carried by glacial meltwaters. During the winter seasons, when melting slowed and water volumes were reduced, the debris-laden valley floors were scoured by strong westerly winds which carried the easily moved, silt-sized material out of the valleys and across the bordering uplands. The sand particles did not move far because of their weight. The silts and clays were picked up and deposited along Iowa's border. The coarser silt particles were heavier so they were dropped at the western edge. The finer silts were carried farther east.

One of the characteristics of loess is the rapid movement of water through the soil. In the Loess Hills area, average rainfall is approximately thirty inches a year. Without the clay particles to fill the gaps between the silt, this water quickly runs through the soil so that it is available to the plants for only a short time. As a result, the area has a large number of plants that have adapted to the arid conditions.

Some people have called the loess soil "sugar clay" because of its ability to "dissolve" so easily in rainwater. Loess that is unprotected by vegetation is very susceptible to erosion. Another example would be to compare the Loess Hills to an M & M candy. The prairie plants on the hills represent the hard candy coating. If the coating (plants) is removed then the chocolate (soil) is exposed and would quickly disappear (erode).

Understanding the characteristics of loess soil will help people conserve the soil and make better choices concerning construction, agriculture and recreation.



The relative size of sand, silt, and clay

PROCEDURE:

Part One

1. First, set up three teaching stations so that students will be able to correctly mix the proportions of cornmeal, baking soda, cornstarch, and water.

   Station 1: Sand Representation
   In a bowl mix 1/4 cup cornmeal with 8 - 10 teaspoons of water

   Station 2: Silt Representation
   In a bowl mix 1/4 cup baking soda with 6 teaspoons of water

   Station 3: Clay Representation
   In a bowl mix 1/4 cup cornstarch with 12 teaspoons of water

2. Lead a discussion on soil. What does it look like? How does it feel? What is in it? Show the relative size comparisons of sand, silt, and clay by using the balls and marble as an example. Explain that the three components of soil have different textures based on the size of the particles. Sand feels gritty. Silt feels smooth, slick, and not sticky. Clay feels smooth, plastic and very sticky.

3. Have students experiment with texture by using the simulated soil materials of cornmeal, baking soda and cornstarch. Which material is able to hold more water? (cornstarch) What does it represent? (clay) The loess soil would be very similar to the silt example. However, the actual color of loess soil is tan. Since clay is missing from the loess soil, the soil is not able to hold as much water as other soils, so it is more erosive and plants in the area have adapted to require less water.

4. Show the students some flour. The flour can represent loess soil. Using a flour sifter, demonstrate how the loess hills were formed by the particles of soil being swept by the wind and deposited along the border of Iowa. (You may want to demonstrate this outdoors where the wind can actually blow the flour, and where the cleanup will be much easier!)

Part Two

1. Collect soil samples from a garden, field, empty lot, woods, prairie and other places.

2. Keeping samples separate, spread the soil on newspaper, crush any lumps and remove large rocks, sticks, or trash.

3. For each soil type, fill a quart jar one-quarter full with soil, label and add water until the jar is 3/4 full. Add one teaspoon of alum, close the lid and shake hard. Let the jar stand for several minutes.

4. Students will see that the mixture separates into layers. The larger particles - coarse sand or rocks - settle to the bottom of the jar. The finer particles of sit and clay will form the next layer. The material left floating on top of the water is called organic matter. Organic matter is made up of dead leaves, twigs, stems and parts of animals and plants. The more organic matter in the soil, the richer it is.

5. Ask your students questions like: How long did it take for all the particles to settle? Did some soil samples take longer than others? If so, why do you think that this happened? Compare the soil samples. Which has the most organic material? In which soil do you think that plants grow best? What could be done to improve the soil with little organic matter?

6. If you do not live in the Loess Hills area, are any of the samples similar to loess soil? Loess soil would have very little or no sand and a great amount of silt. Organic matter would vary depending on where the sample was taken.

EVALUATION: Students can divide a page in their science journals into thirds. On each third have them describe the characteristics of clay, silt, and sand; their relative sizes; their texture; and their ability to hold water.

EXTENSIONS:

1. Show examples of land use such as : a construction site; a lawn; a farm; a park; a mall; etc. Ask students to choose which of the uses would cause the most soil erosion. Brainstorm with your students to find ways that the erosion could be controlled. Ask what role plants play in erosion control.

2. For Part One use actual soil samples. Contact your area Soil and Water Conservation District, Natural Resources Conservation Service, or County Conservation Board for assistance in locating examples of sand, silt, and clay. Look at additional characteristics of soil such as color, looseness of soil, and aeration.

3. Compare plants found in the Loess Hills prairies to those found in the tallgrass prairies. Which prairies contain more aridity-loving or desert-like species? (Loess Hills) Why? (Loess soil contains very few clay particles, thus it is well-drained and very dry.)

RESOURCES: Activity “Profiles of Soil” from Project Bluestem. Prairie City, IA: Neal Smith National Wildlife Refuge and Prairie Learning Center.

Activity “Shake-A-Jar” from Iowa’s Soil - A Teacher’s Guide to Soil Activities. Guthrie Center, IA: Iowa Conservation Education Council.

Mutel, Cornelia F. (1989). Fragile Giants, Iowa City, IA: The University of Iowa Press.

Office of Environmental Education. (1990). Project Stewardship Minnesota, St. Paul, MN: Office of Environmental Education.

Prior, Jean C. (1991). The Landforms of Iowa, Iowa City, IA: The University of Iowa Press.

Website: www.loesshills.com

GLOSSARY:

Arid - dry

Erosion - the wearing down or washing away of the soil and land surface by the action of water, wind or ice.

Loess - windblown silt with minor amounts of sand and clay.

Silt - very fine particles of earth, sand, and clay, etc. often transported by water and deposited as sediment.

Soil - the top layer of the Earth's surface, containing unconsolidated rock and mineral particles mixed with organic material.

Skipper Survivors

Target Grades: 3 - 5

SUMMARY: Students will become "skipper butterflies" to look for one or more components of habitat during this physical activity.

OBJECTIVES: Students will be able to recognize habitat suitable for skipper butterflies

Students will be able to recognize skipper butterflies as a prairie obligate

Students will be able to list factors attributing to habitat destruction in the Loess Hills

GROUP SIZE: Any number

DURATION: 45 minutes

KEY WORDS: limiting factors, habitat, skipper butterfly, cover, shelter, endangered species, prairie obligate

STANDARDS: *Science Standards*
Characteristics of organisms
Life Cycles of organisms
Organisms and environments

Standards for the English Language Arts
Students use spoken, written, and-visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

MATERIALS: Five colors of construction paper (two to three sheets of each color); one black felt pen; ziplock plastic bags or small paper bags (one per student).

BACKGROUND INFORMATION: In this activity, skipper butterflies are the focus in order to illustrate the importance of suitable habitat for insects in the Loess Hills. One or more components of habitat - food, water, shelter, and space in a suitable arrangement - are emphasized as ways to convey the concept of "limiting factors".

Skippers (Family Hesperiidae) are small, drab butterflies with large heads, thickset bodies, and short wings. Their antennae are set rather far apart on the head and end with a small hook. In contrast to other butterflies, which hold both wings either vertically or horizontally at rest, skippers often rest with fore wings open at about a 45-degree angle and hind wings horizontal. They earned their names from the characteristic way that they dart from flower to flower. Like all butterflies, skippers go through complete metamorphosis in their life cycle: egg, larva (caterpillar), pupa and adult. Skipper butterflies feed on grasses and wildflowers on the prairies. Skippers pupate in a cocoon of leaves and silken strands. In Iowa's Loess Hills, the skippers are prairie obligates, species that cannot survive in other plant communities. Many butterflies lay their eggs on only one or a few plant species. If the prairie plants that the butterflies depend upon disappear, the butterflies also disappear.

Hesper's ottoe male

Most prairie obligates have declined considerably because of loss of prairie habitat and are now rare across the United States. Few if any prairie obligates can be expected on tracts of less than 15 or 20 acres, and as much as 1,000 acres of prairie may be needed for long-term maintenance of such species. In Iowa, the Neal Smith National Wildlife Refuge, located near Prairie City, Iowa, and portions of the Loess Hills are able to maintain substantial populations of the Ottoe skipper and smaller populations of the rare Pawnee skipper and dusted skipper. Loess Hills populations of the Ottoe skipper are among the largest remaining in the world. These rare skippers need quality prairie to survive. They rely on prairie plants for nectar as a food source. Some skippers may also extract organic nutrients from decaying matter and wet mud in the prairie. They require plants for shelter from predators and weather. The prairie plants also serve as host plants and food for larvae. The skippers pupate over winter in the leaves of prairie grasses that have collected on the ground.

Prairies in Iowa are subjected to numerous threats including: development of land for cities, homes, industries or agriculture; succession of woody plant species; and invasion of exotic plants such as leafy spurge. The lack of fire has contributed, in part, to greater woody succession. However, aggressive fire management and burning of entire prairie areas at once can destroy the insect species that live in the prairie. Fire kills butterfly eggs, caterpillars and pupa which are located in the dead grasses on the ground.

All components of habitat are important. Food, water, shelter and space must not only be available but must also be available in an arrangement suitable to meet animals' needs. Inadequate food, water, shelter or space would be limiting factors in any animal's survival.

PROCEDURE:

Getting Started

Cut paper into 2" x 2" squares. For a class of 30 students, make 150 squares. Make 30 cards of each of the five colors to represent the habitat components as follows:

Food	30	Mark with the letter "F"
Host Plant	30	Mark with the letter "H"
Shelter	30	Mark with the letter "S"
Winter shelter	30	Mark with the letter "W"
Prairie	22	Mark with the letter "P"
Forest Encroachment	2	Mark with the letter "E"
Development	3	Mark with the letter "D"
Threatening exotics	1	Mark with the letter "T"
Prairie Burn	1	Mark with the letter "B"
Insecticides/Pesticides	1	Mark with the letter "X"

For the purpose of this activity, these are defined as follows:

Food - Skippers require an energy source, nectar from flowers. The prairie provides a great diversity of flowers for the skippers.

Host Plant - Skippers require a place to live. Prairie plants provide a place for skippers to lay their eggs, and once hatched, the larvae (caterpillars) feed on that same plant.

Shelter - Skippers require a place to be safe from predators and from the weather.

Winter Shelter - Skippers will pupate and overwinter in the dead grasses of the prairie.

Prairie - A diverse habitat of grasses and flowers and the home for insects, birds, mammals, reptiles, amphibians and people.

Development - A process of change where an original area is added to, or reduced to produce a change. (Loess soil from the Hills has been used for fill dirt for development projects in Nebraska.)

Woody Encroachment - prairies are lost through natural succession of plant communities.

Threatening Exotics - non-native plants that invade an area

Prairie Burns - Natural (lightning) or managed burning of prairie

Insecticides/Pesticides - chemicals used to control pests

PROCEDURE:

1. In a fairly large open area (e.g., 50′ x 50′), scatter the colored pieces of paper.

2. Have the students line up along one side of the area. Tell them they are to become "skipper butterflies" for the purpose of this activity. Review the concept of "habitat" that a skipper would need: food, water, shelter, and space in a suitable arrangement in order to survive. Do not tell the students what the letters on the cards mean. Tell them only that they represent one element or component of skipper habitat.

3. Direct the students to move as individual "skippers" through the area. Each skipper must pick up as many of the components of habitat as possible and put the pieces in their bags. Continue until all of the pieces have been collected. Some competitive activity is ok as long as it is "under control".

4. When the students have collected all of the squares of paper in the area, have them return to the classroom or be seated in a comfortable area. Ask the students to separate the pieces of paper into piles according to the letters on each. Using a chalkboard, or a large pad for visual reference, ask the students to guess what the letters on the cards represent - giving them the clue that each is an element of habitat for a skipper.

5. What kinds of shelter would a butterfly need? What do these letters represent? Explain what the letters mean now. How many students collected at least one kind of shelter? For the purpose of this activity, only those students who gathered at least one of the necessary shelter cards (F, H, S, W, and P) could survive. If the students had any of the letters (E, D, T, or B) these were negative factors for their habitat, and they were not able to survive.

6. Ask the students what would happen if a skipper has all types of shelter except the host plant on which to lay its eggs? (The caterpillars would hatch and not survive because they couldn't eat the plant on which they hatched.) What if their overwinter sites were destroyed by a prairie burn? (The pupa would die in the burn.) Suggesting that the students need one of each kind of shelter represents the importance of appropriate shelter as a necessary component of an animal's habitat.

7. In this activity, what was a limiting factor for this population of skippers? (shelter) Would food be a limiting factor of skippers? (Yes, especially for the caterpillar stage of their life.)

EVALUATION: Have the students draw pictures of what makes a good skipper butterfly habitat. Give each student pieces of clay to make models of skipper butterflies, requiring that the individual body parts and specific features of skippers are labeled. Test students understanding by having them fill out a "Research Report Pattern" completing the statements to show their knowledge.

Research Report Pattern

If I were
I would be
I could be
But I would not be
Because that would be

Possible answers could be: If I were a skipper butterfly, I would be a prairie dweller, I could be a caterpillar, but I would not be a bird, because that is a vertebrate.

EXTENSIONS:

1. Role play with students about prairie management. Have them imagine that they each have 100 acres of prairie to manage. What might they do to help the butterfly populations?
2. For a more dramatic effect, create the set of cards to contain a greater number of prairie threats. For example:

   15 cards with "P" for prairie
   8 cards with "D" for development
   3 cards with "E" for encroachment
   2 cards with "T" for threatening exotics
   2 cards with "B" for prairie burns

   How might this affect of your butterfly population?

RESOURCES:

Heitzman, Richard J. & Joan E. (1987). Butterflies and Moths of Missouri. Jefferson City, MO: Missouri Department of Conservation.

Mutel, Cornelia F. (1989). Fragile Giants,. Iowa City, IA: The University of Iowa Press.

Pyle, Robert Michael & Sarah Ann Hughes. (1983). Peterson Field Guide Coloring Books - Butterflies. Boston, MA: Houghton Mifflin Co.

Stokes, Donald & Lillian. (1991). The Butterfly Book,. Boston, MA: Little, Brown, and Company.

Scientific Art~

Describing and Recording Nature

Target Grades: 3 - 5

SUMMARY: After students learn of the scientific work of Lewis and Clark, they will work as partners to describe and record (draw) animals of the Loess Hills.

OBJECTIVE: Students will learn the abilities necessary for and the process of scientific inquiry by replicating the work of Lewis and Clark while on an imaginary expedition in the Loess Hills.

GROUP SIZE: Any number

DURATION: Teacher preparation- gathering of resources, 1-2 hours
Art activity, 30 - 45 minutes
Follow up research, 1-2 class periods

KEY WORDS: habitat, adaptations, Lewis and Clark, journal

STANDARDS:

Science Standards
Abilities necessary to do scientific inquiry
Understanding about scientific inquiry
Organisms and environments

National Geography Standards
Understands that culture and experience influence people's perceptions of places and regions

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

BACKGROUND INFORMATION: When the explorers Lewis and Clark were sent by President Jefferson to explore the new land west of the colonies in 1804, they recorded observations and made sketches of the plants and animals they saw on their journey. Like other scientists, Lewis and Clark used journals to record this information. During their expedition, they passed through the Loess Hills region and recorded not only their observation of the unusual landform, but also the unique plants and animals of the area. During the course of their journey, Lewis and Clark gathered information on 178 new kinds of plants, 122 new kinds of animals, and more than 40 Native American tribes.

PROCEDURE:

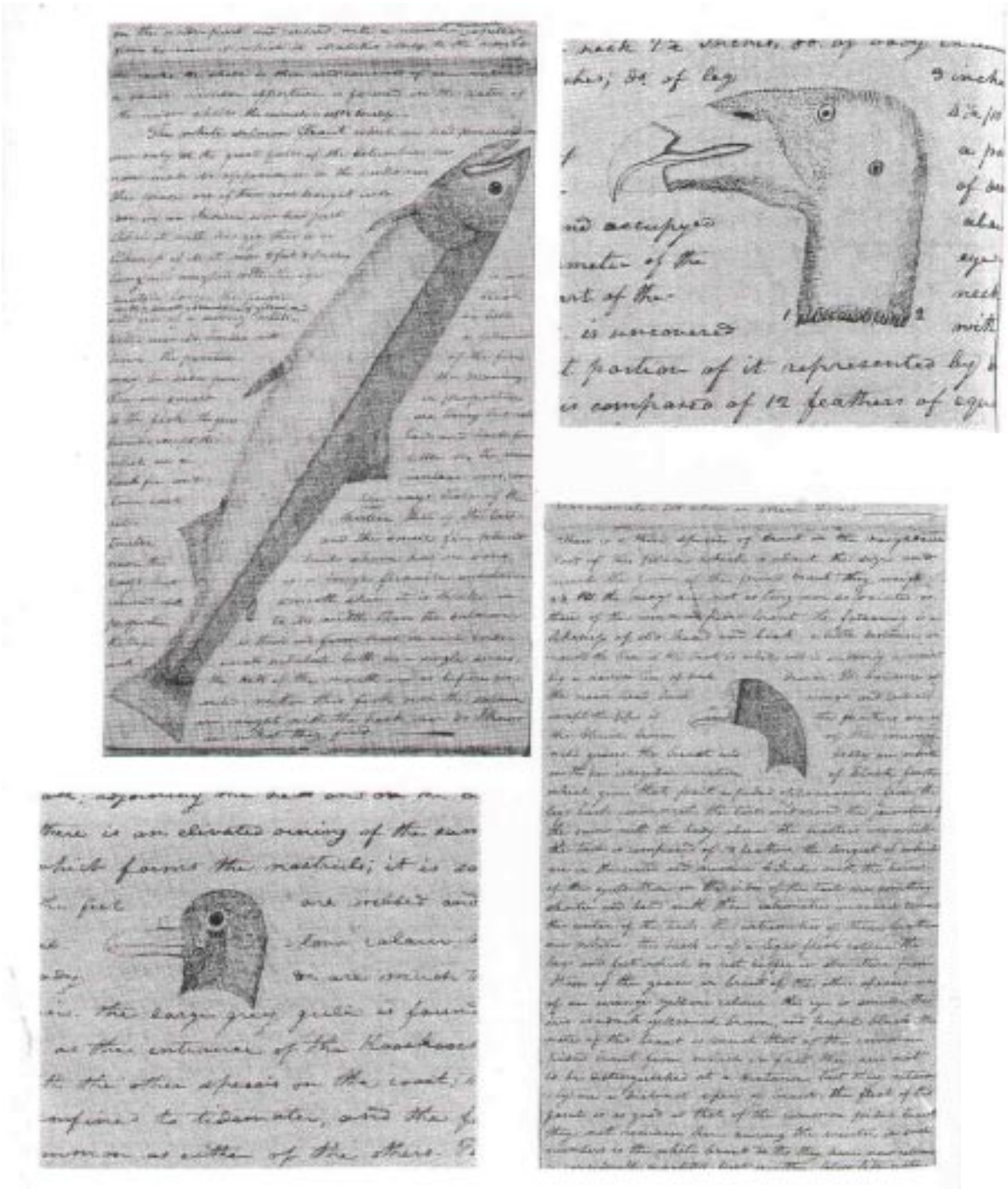
1. Gather pictures of several animals from calendars, magazines, field guides, and perhaps the internet. (See resource section for help.)

2. Invite your students to take an imaginary journey through the Loess Hills with the explorers, Lewis and Clark. Tell them they will be seeing and describing animals that "no one has ever seen before'.

3. If desired, students may make their own "Lewis and Clark" journal to record information and draw sketches in. (Half sheets of natural colored paper with a fabric or wallpaper cover bound with twine or leather strips will give a look of "authenticity'.)

4. Students should work as partners. Give one partner an animal picture, instructing them not to show it to their partner. The student with the picture (journalist) describes the animals with as much detail as possible to his/her partner. The partner (artist) may not ask questions. This will show the importance of describing everything about the animal. The artist then draws the animal. The journalist may watch, but not "add" any more detail, and this will be tempting. When the artist is finished, together the two can discuss the drawing and the picture it was to represent. Then the two switch, with a new animal picture.

EVALUATION: Students should share with the class their drawings and tell of the positive and negative aspects of their collaboration (not enough detail given, gave good directions, etc.). Class can judge which pair would make the best investigative team.



Lewis's sketch of, clockwise, a trout, a vulture, a brant, and a gull, in his journal.
(Courtesy American Philosophical Society)

EXTENSIONS:

1. Follow this activity with "Amazing Animals" and have your students research and classify the animals they've drawn.

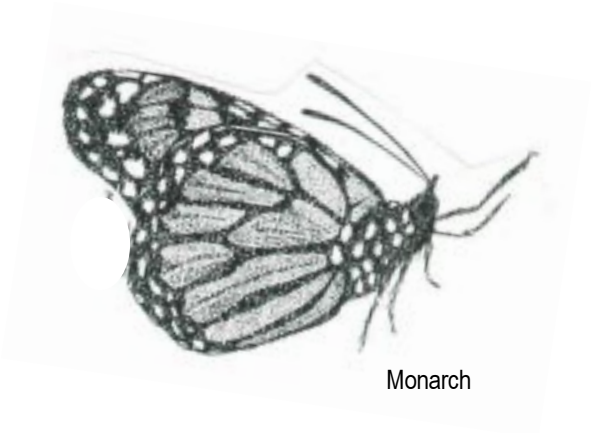
2. Have students add pages to their Lewis and Clark journal by adding Loess Hills plants. (See "Hot Heads, Dry Feet- Prairie Plants of the Loess Hills" activity for drawings and information on the plants.)

3. Read excerpts from one of the Lewis and Clark journals. Have your students add to the stories with ideas of their own using their journals.

4. Display the pictures and the sketches in the hallway.

RESOURCES:

Animal Tracks by Arthur Dorros
Dover Coloring Books, various animals
Grasslands by Lauren Brown
The Lewis and Clark Expedition Coloring Book by Peter F. Copeland
Lewis and Clark Explorers of the American West by Steven Kroll
Loesshills.com
Sacajawea: The Journey West by Elaine Raphael & Con Bolognese
The Incredible Journey of Lewis and Clark by Rhoda Blumberg
Zoomschool. com/coloringbook
Undaunted Courage by Stephen E. Ambrose



Monarch

Sandhill Crane

The Earth Lodge People: How Did They Do That?

Target Grades: 3 - 5

SUMMARY: Students will construct an earth lodge using natural materials and drawings based on the lodges excavated in and around Glenwood, Iowa.

OBJECTIVES: The students will learn about the Glenwood Culture. The students will discover the difficulties and hidden technologies involved in building a simple structure.

GROUP SIZE: Any number

DURATION: Introduction of Glenwood Culture, one class period
Construction of "Glenwood structure", 2-3 class periods

KEY WORDS: Glenwood Culture, lodge, timbers, depression, horticulture, cache pit, hearth, profile, lintels, boughs

STANDARDS:

Science Standards
Properties of earth materials
Abilities to distinguish between natural objects and objects made by humans

National History Standards
Students should develop an understanding of the characteristics of societies in the Americas.
Students should develop an understanding of the biological and cultural processes that shaped the earliest human communities.

National Geography Standards
Understands the physical and human characteristic of place. Understands that culture and experience influence people's perceptions of places and regions.

MATERIALS: All natural materials gathered by students, and a base material, such as styrofoam or a pop flat, one per student.

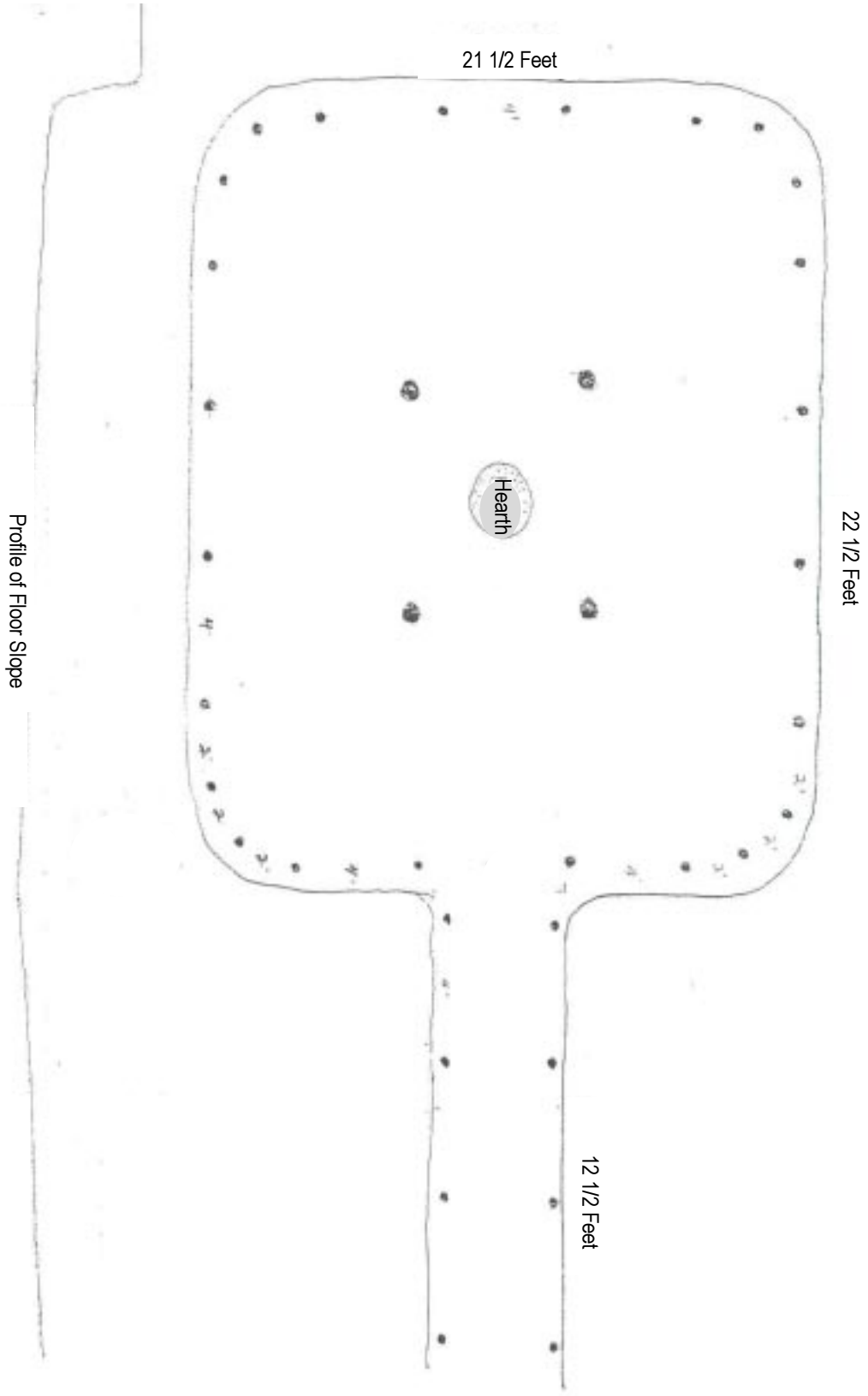
BACKGROUND INFORMATION: The Glenwood Culture was one of three major village farming cultures in the Loess Hills. To the north, the Great Oasis Culture built lodges in clusters inside forts to protect themselves from enemies. Further south, the Mill Creek Culture farmed and raised corn along the Missouri River tributaries. To the south, the Glenwood Culture built loosely grouped earth lodges along creeks, in sheltered valleys and also on ridge tops.

This activity will focus on the Glenwood Culture believed to have lived in the Loess Hills between approximately 900 -1300 A.D. The people were hunters of deer, elk, bison, rabbits, squirrel, turtles and birds. They gathered nuts, berries, and seeds. They were also horticulturists, raising squash, corn and beans. They were fishermen as well, as suggested by the bone hooks found in archeological excavations of their dwellings.

The Glenwood people constructed earth lodges by digging out a depression approximately 2 to 3 feet deep and erecting a wooden framework covered by grass and earth. Their lodges varied in size depending perhaps on the building site or the size of the extended family living there.

Typically, four 12-15 foot poles were set in holes that formed a square in the middle of the lodge's depression site. These holes were described as being "an arm and a clamshell deep", since the hole could only be dug as deep as a man could reach down and bring up the dirt

The floor plan of a Glenwood house appears at left. Structures were generally 30 feet square with four main roof supports and a south-facing entrance. Note undercut storage pits (dashed lines) and central fire pit. The houses may have had sod roofs as shown in the reconstruction above.


21 1/2 Feet
Hearth
22 1/2 Feet
Profile of Floor Slope
12 1/2 Feet

with a clamshell. Logs were then laid over the tops of the 4-cornered square in forks left at the top. Smaller posts were set around the perimeter of the lodge inside the depression and support posts were laid across their tops. Smaller logs were then laid between the sidewalls and the center structure to form a roof but leaving an opening for a smoke hole in the center of the top. Branches were laid against the sidewalls to form supports for grass and earth walls. A thatch of evergreen boughs or tall grasses were laid over the logs and thin branches were then woven between the support posts to close in the structure.

Earth and grasses were then mixed with water and plastered over the outside and daubed on the inside. A 20 -foot entrance tunnel was built to provide protection from the elements and ventilation for the cooking fire that turned in the middle of the lodge in the hearth. The entrance began at about 4 feet in height and increased to 7-8 feet at the entrance of the lodge. Cache pits were dug inside the lodge for storage of foods, and were later used as trash pits. Family members slept and ate around the inside perimeter of the lodge.

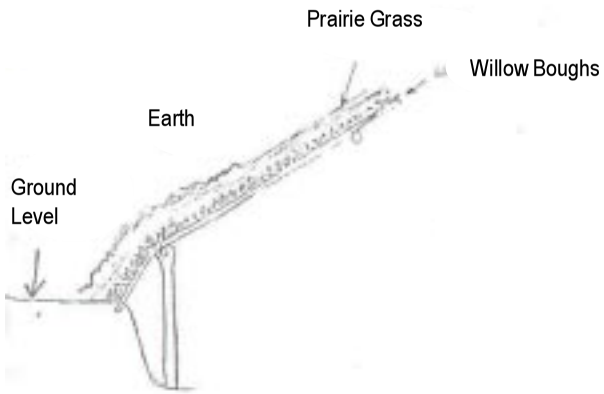
Trees used for the construction of the lodge were burnt off since the culture had no stone axes at that time. Construction was done without nails so logs were buried deep, wedged, leaned, or simply laid on the support structure, covered with grasses and/or branches and weather proofed with earth. (The accompanying diagrams graphically show how the structure probably looked.)

PROCEDURE:

1. Introduce students to the Glenwood Culture by providing them with a number of resources to research, show them the suggested video, share the background information from this lesson, and if possible, take a class field trip to Glenwood, IA to see an actual reconstruction of a Glenwood Culture earth lodge, or to the Mills County Museum to see artifacts from excavations of early Glenwood Culture sites.

2. Have students discuss the process of constructing an earth lodge. Ask them to estimate the types and number of materials that they will need to build their own model of a Glenwood structure. Have them record these estimates, and sketch the structure they will build.

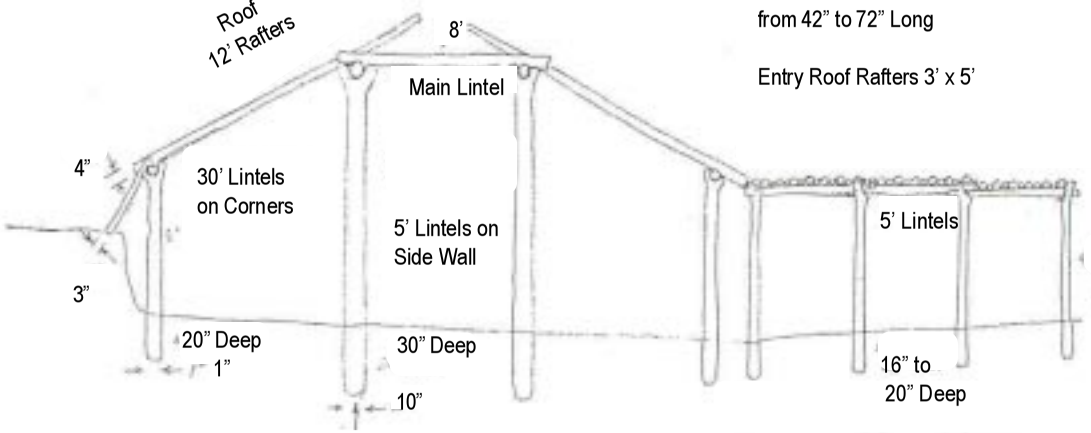
3. The students will then be required to gather the materials needed, and build a model of an earth lodge that reflects the information that was reviewed about the Glenwood culture's shelters. The students must use all natural materials, leave one side open to show four central support posts, posts for walls and the entrance, and the overall construction of the lodge. A model should also show cache pits and a hearth. All natural materials must be used except for the base on which the construction takes place.



Leave 3" to 4" Projection of any
Branch on Posts and Rafters

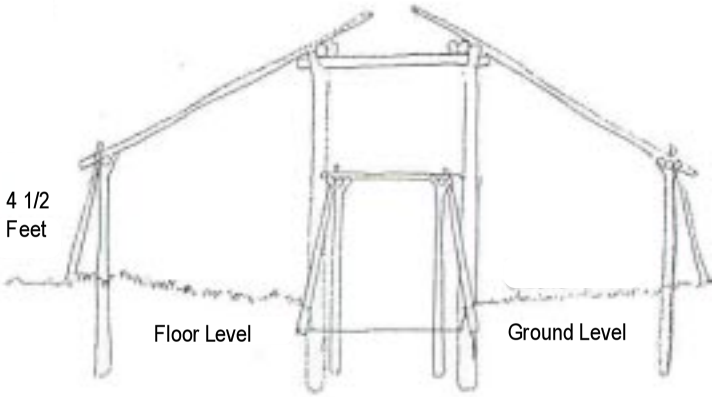
Wall Rafters 3" Diam
from 42" to 72" Long

Entry Roof Rafters 3' x 5'



12' to Crotch for Main Supports

7 1/2' to Crotch for Wall Supports



EVALUATION:

Earth Lodge Rubric

1. The lodge is attempted, but is essentially just a pile of sticks with mud and a little grass thrown in. All natural materials were not used.

2. The lodge has some form, but it is not complete and does not look like a Glenwood culture earth lodge. All natural materials are used.

3. The lodge is well formed with an entrance, 4 corner posts and side posts. Sticks are used to construct the roof, it is covered with dirt and grass, and has an open side to display the hearth and cache pits. All natural materials were used.

4. The lodge was perfectly formed with a sloping entrance, four-corner construction with side posts, and leaning posts, sticks that form a roof with an opening for smoke. It is covered with grasses and earth, except for one side, which is open showing a cache pit, hearth, and perhaps other areas in the lodge. All natural materials were used.

EXTENSION: Several of the lessons in Shirley Schermer's book, Discovering Archaeology would allow students to see the connection between culture and science.

RESOURCES: "A Place Apart - Loess Hills", a video which can be obtained from the Glenwood Library.

Alex, Lynn Marie. (1995). Prehistoric Cultures of Iowa. Iowa City, IA: the University of Iowa Printing Department.

Anderson, A.D. (1961). "The Glenwood Sequence." Iowa City, IA: Journal of the Iowa Archeological Society.

Anderson, Duane. (1975). Western Iowa Prehistory. Ames, IA: Iowa State University Press.

Mills County Historical Museum, Glenwood, IA.

Mutel, Cornelia F. (1989). Fragile Giants. Iowa City, IA: the University of Iowa Press.

"Ours to Care For", a video available from the Loess Hills Preservation Society.

Schermer, Shirley. (1992). Discovering Archaeology. Iowa City, IA: Office of the State Archaeologist.

Hot Heads, Dry Feet: Prairie Plants of the Loess Hills

Target Grades: 3 - 5

SUMMARY: Students will observe, identify and understand the uniqueness of the prairie plants of the Loess Hills.

OBJECTIVE: Students will be able to identify plants unique to the dry, hot, windy conditions of the Loess Hills.

GROUP SIZE: Any number

DURATION: Introduction: 30 minutes to 1 hour
Field trip: one school day
Follow-up: 1-2 hours

KEY WORDS: forbs, whorled, opposite, alternate, compound, perennial, annual, stem, leaves, flowers, stamen, pistils, sepals, fruit

STANDARDS: *Science Standards*
Abilities necessary to do scientific inquiry
Characteristics of organisms
Organisms and environments

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

MATERIALS: Field guides to flowers and grasses, sketch pads, pencils, copies of the prairie plants included with lesson. (See resource section of this lesson for suggested guides.)

BACKGROUND INFORMATION: The plants of the Loess Hills have adapted to the porous soil, sunlit hillsides, strong winds, and cold winter days that create a desert-like environment. The plants exhibit four major traits that allow observers to distinguish Loess Hills prairies from other grasslands.

1. Colors that help to regulate temperature such as leaves that are darker on one side than the other. The plant will, for example, turn the lighter side of the leaf to the sun to keep cool. Whitish hairs on stems and leaves that reflect the sun's energy are examples of adaptations.

2. Long roots that may grow many times deeper than the height of the plant to reach moisture deep within the sandy, porous soil.

3. Moisture preserving characteristics such as waxy leaves, spike-like leaves, small leaves, and smaller growth patterns are common among plants of the Loess Hills. (These characteristics are more often found in desert plants than in typical prairie plants found in other parts of the mid or tallgrass prairie region.)

4. The prairie is made up of primarily warm-season plants that green up in late spring, while non-native species turn green in early spring. As a result, many native grasses and forbs produce seed in late summer or autumn so flowers and fruit heads appear later than non-native species. The Loess Hills prairie plants turn a russet color in the fall and winter as contrasted with the washed-out tan color of non-native grasses. The plants retain distinguishing dried seed pods and flowers or seed heads that last long after the flower has bloomed.

One of the best times to observe Loess Hills prairie plants is in the fall since many of the species are still blooming or have only recently produced seed heads or pods that are easy identifiers of the plants. It is a great time for field trips to local wildlife areas, preserves, old cemeteries that retain many native plant species, or to a park or a nature center. Iowa has an abundance of such areas that are easily accessible and which often have local experts who can share their knowledge with students. Conservation officers, Department of Natural Resources personnel, park rangers, naturalists, Iowa Nature Conservancy personnel, or local people knowledgeable of the plants of the area are but a few resource persons who may be available to classes interested in visiting a prairie. Even some private landowners welcome visitors to the native prairies that they have carefully preserved on their farms.

PROCEDURE:

1. Introduce students to the plants of the Loess Hills by providing a set of drawings to each group of students (group into 4's).

2. Indicate that the plants have adapted to the unique conditions of the Loess Hills (associated with the porous soil). Give examples such as telling about the yucca, skeleton weed, prickly-pear cactus and locoweed which are typically found in the dry, desert-like lands in the western United States. These plants possess traits that prevent desiccation (drying out). Great -flowering beardtongue's waxy coating prevents excessive evaporation. The skeleton weed's near absence of leaves and the yucca's thickening of leaves reduce moisture loss by reducing the surface to volume ratio. The silky aster's whitish hairs reflect the sun's energy. Deep roots, low stature, small leaves, thick outer covering, and abundant surface hairs are drought resistant features typical of many species growing in these dry hill prairies.

3. Now ask the students to sketch each of the Loess Hills prairie plants in their notebooks or journals, labeling not only the plant name, but also noting unique adaptations the plant may have to adjust to the Loess Hills habitat. (Have a variety of field guides available, and spend a few minutes introducing them to your students. It will be helpful for students to know that guides are not all arranged in the same manner. Some are arranged by flower color, some by blooming time, and some by alphabetical order of the genus and species. This will not only help with their research, but also be a valuable tool for them to utilize on your field trip to a prairie.)

4. After examining the drawings of the prairie plants, students can apply their new knowledge by taking a field trip to the Loess Hills. (The best way to experience the Loess Hills is to visit them. If your school is within traveling distance, a field trip to a nature area or preserve would be a worthwhile experience. If this is not possible, use alternatives such as videos, websites, CD virtual trips, or the Loess Hills kit available through your local Area Education Agency.)

EVALUATION: Have students evaluate each other and themselves by using their drawings to name the grasses and forbs typically found in the Loess Hills. Students should be able to name 3-5 grasses, and 5-10 flowers found in the hills by seeing a picture or sketch of the plant.

EXTENSION: Teachers may wish to require students to identify, sketch, and label additional plants to achieve a satisfactory grade. Further extensions of this activity will depend on the resources the teacher finds available and on the grade and/or subject to which this lesson is applied.

RESOURCES:

Brown, Lauren. (1979). Grasses. New York, NY: Houghton Mifflin Co.

Christiansen, Paul & Mark Müller. (1999). An Illustrated Guide to Iowa Prairie Plants. Iowa City, IA: The University of Iowa Press.

Forey, Pamela & Cecilia Fitzsimons. (1986). An Instant Guide to Wildflowers, New York, NY: Bonanza Books.

Jaques, H.E. (1949). Plant Families. How to Know Them. Dubuque, IA: Wm. C. Brown Publishing Company.

Mutel, Cornelia F. (1989) Fragile Giants,. Iowa City, IA: The University of Iowa Press.

Peterson, Roger Tory & Margaret McKenny. (1968). Field Guide to Wildflowers. New York, NY: Houghton Mifflin Company.

Pohl, Richard W. (1993). Keys to Iowa Vascular Plants, Ames, IA: Iowa State University Press.

Runkel, Sylvan T. & Dean M. Roosa. (1989). Wildflowers of The Tallgrass Prairie. Ames, IA :Iowa State University Press.

Walters, Dirk R. & David J. Keil. (1975). Vascular Plant Taxonomy Dubuque, IA: Kendall Hunt Publishing Company.

Zim, Herbert S., Ph.D. & Alexander C. Martin Ph.D. (1987). Flowers: A Guide to Familiar American Wildflowers. Racine, WI: Western Publishing Company, Inc.

SIDE-OATS GRAMA
Bouteloua curtipendula
(Michx.) Torrey

Stem: perennial; tufted; flowering stalk 2′ to 3′ tall, lightly hairy.
Leaves: sheath smooth but with stiff, marginal hairs; ligule 1/32″ long, fringed; blade with auricles at the base, stiff marginal hairs near the base or sometimes only marginal bumps; 6″ to 8″ long, tapered to sharp tip.
Inflorescence: many short spikes attached on one side of the zig-zag flower stalk; each spike 1/4″ to 3/8″ long; inflorescence 4″ to 8″ long.
Spikelets: 3/16″ long, glumes as long as the lemmas, one fertile floret per spikelet, with red anthers; flowering from mid-June to early July.
Fruits: spikes drop as a unit; fruiting begins in early July; fruits begin dropping in mid-August.
Habitat: common on dry prairies and Loess Hills prairies.

SCARLET GAURA
guara coccinea
Pursh

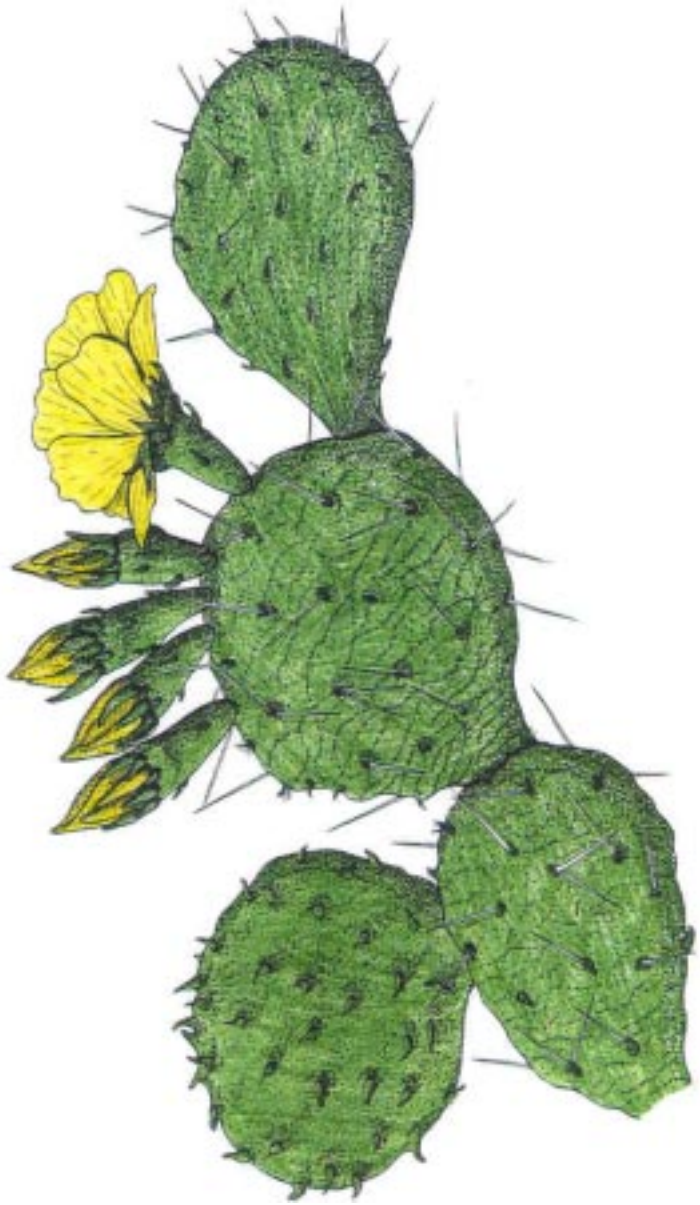
Stem: perennial; 1′ to 2′ tall; branched above; hairy.
Leaves: alternate; oval, 7/8″ by 1/4″; some with a large rounded tooth near the base on each side; upper leaves smaller; hairy above and below.
Inflorescence: spikes at the tip of leafless stalks from the upper branches; flowers very crowded when flowering but 1/4″ apart in fruit.
Flowers: petals red, 3/16″ long, attached to 3/16″ floral tube atop 1/8″ hairy ovary-sepals re-curved, 3/16″ long; flowering from early June to mid-August.
Fruits: pear-shaped, four-angled capsules, 5/16″ long, hairy; above bracts of the same length; fruiting begins in mid-June.
Habitat: infrequent on dry Loess Hills prairies.

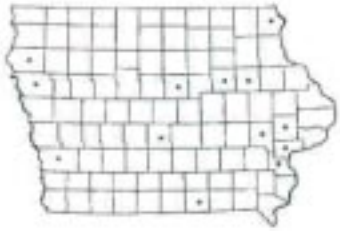
RUSH-PINK
Skeleton weed
Lygodesmia juncea (Pursh)
D. Don

Stem: perennial; 1′ to 2′ tall; much branched; smooth; ribbed; with milky juice in the stems; often with spherical galls I″ in diameter.
Leaves: alternate; tiny, lance-shaped (about 1/4″ long); smooth.
Inflorescence: single heads at the tips of the branches.
Heads: three to five pink ray flowers per head, 3/16″ long; fillaries in two rows, the outer (lower) very tiny, the inner 1/2″ long with darkened tips; flowering from mid-June to mid-July.
Fruits: "seeds" (fruits) 1/16″ long; plumes of many fine hairs, 3/8″ long; fruiting begins in late June.
Habitat: common on Loess Hills prairies and dry, gravelly prairies; often associated with disturbance.

EASTERN PRICKLY PEAR
Opuntia humifusa (Raf.) Raf.
0. compressa (Salisb.) J. P. Macbr.

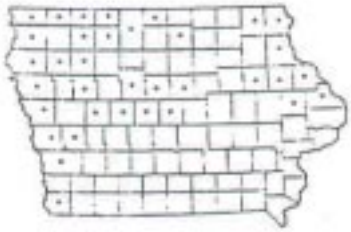
Stem: joints flattened into fleshy, oval segments about 4 1/2″ long, dull green; with 1/2″ (1″) spines solitary or in pairs.
Inflorescence: few flowers attached to the upper, curving edge of terminal joints.
Flowers: many yellow petals, about I″ long, many stamens and a single style; ovary tapering, petals attached at the top of the ovary (inferior ovary), with spines; flowering from mid-June to mid-July.
Fruits: red, columnar, 1″ to 2″ long.
Habitat: very infrequent; only on dry, rocky, or sandy prairies.





DOWNY PAINTED CUP
Castilleja sessiliflora
Pursh

Stem: perennial; 1′ to 1 1/2′ tall; little branching; sometimes several stems from one root crown; densely hairy:
Leaves: mostly alternate, crowded; linear, 1″ by 1/8″; usually with three diverging lobes at the tips; sessile: hairy above and below.
Inflorescence: raceme; with a three-lobed bract below each flower, nearly equaling the flower in length; flowers crowded; inflorescence up to 8″ long.
Flowers: calyx pale yellow, tubular, hairy, 1″ long, two-lipped, upper lip 1/4″ longer than the lower; corolla two-lipped, protruding 5/8″ beyond the calyx; flowering from mid-May to mid-June.
Fruits: capsules two-lipped, 1/2″ to 5/8″ long by 1/4″ in diameter; developing within the calyx.
Habitat: common on dry to mesic prairies, especially on the Loess Hills prairies of western Iowa; very infrequent in eastern Iowa.



SOAPWEED YUCCA
Yucca glauca
Nutt. ex Fraser

Stem: perennial; basal leaves and a tall flower stalk to 5′ tall.
Leaves: basal; numerous; linear, gradually tapering to a tip; 1′ to 2′ by 1/2″: threads on the margins; smooth above and below.
Inflorescence: raceme at the tip of the flower stalk; raceme 6″ to 2′ long; each flower attached to the flower stalk above a bract, I″ long, lance-shaped.
Flowers: petals and sepals white, large (I 1/2″ long), forming a cup-shaped flower; on a curved stalk, the flower facing downward; flowering from early to mid-June.
Fruits: capsule, 1 1/2″ to 2″ long by I″ in diameter, held upright; three-chambered with many flat, black seeds; fruiting begins in late June.
Habitat: frequent on west- and southfacing Loess Hills prairies in the western tier of counties in Iowa.

Soapweed is pollinated by night-flying moths who use the ovary of the flower as the site to lay their eggs. The young larvae eat the developing seeds.

SILKY ASTER
Aster sericeus
Vent.

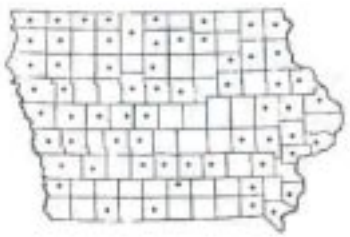
Aster sericeus is shorter (1′ to 2′) than A. lanceolatus, with wiry stems and smaller, sessile leaves (upper 3/8″ by 3/16″) which are silky above and below. The lower leaves drop during the flowering season. In the heads the rays are purple to violet. Flowering is from early to late September, with fruiting beginning in mid-September. A. sericeus is infrequent on dry, rocky, and sandy prairies.

LITTLE BLUESTEM
Schizachyrium scoparium
(Michx.)
Nash
Andropogon scoparius
Michx.

Stem: perennial; tufted; flowering stalk 2′ to 3′ tall; smooth; very flat at the base of the stem.
Leaves: sheath smooth or hairy; ligule 1/ 16″ fringed; blade 6″ to 8″ by 3/32″, long-tapering to a sharp point.
Inflorescence: single spikes from the upper leaf axils; about 1″ long.
Spikelets: similar to big bluestem; the stalk supporting the male flowers is long-hairy, especially toward the tip and curved backward; perfect (male and female) spikelets with a twisted awn, 1/2″ long; flowering from mid-July to late August.
Fruits: similar to big bluestem, each unit 1/4″ long; fruiting begins in early August; fruits begin dropping in mid-September
Habitat: common on dry prairies to Loess Hills prairies; less common on mesic prairies; often on roadsides and in open places.

MILK VETCH
Astragalus canadensis L.

Stem: perennial; 2′to 3′tall; branched above; lightly hairy.
Leaves: alternate; pinnately compound; 5″ by 2 1/2″; leaflets oval with rounded bases and tips, small points at the tips, 1 1/4″ by 1/4″; hairy above and below.
Inflorescence: raceme of crowded flowers to 10″ long on leafless, hairy stalks from upper leaf axils.
Flowers: corolla greenish cream; showing 1/4″ to 1/2″ beyond calyx; calyx tubular, 1/4″ long with points 1/16″ long, hairy; flowering from mid-July to early August.
Fruits: pod 1/2″ long, smooth; fruiting begins in late July.
Habitat: frequent on wet to dry prairies and in open woods, on roadsides, and in open places; more common with some disturbance.

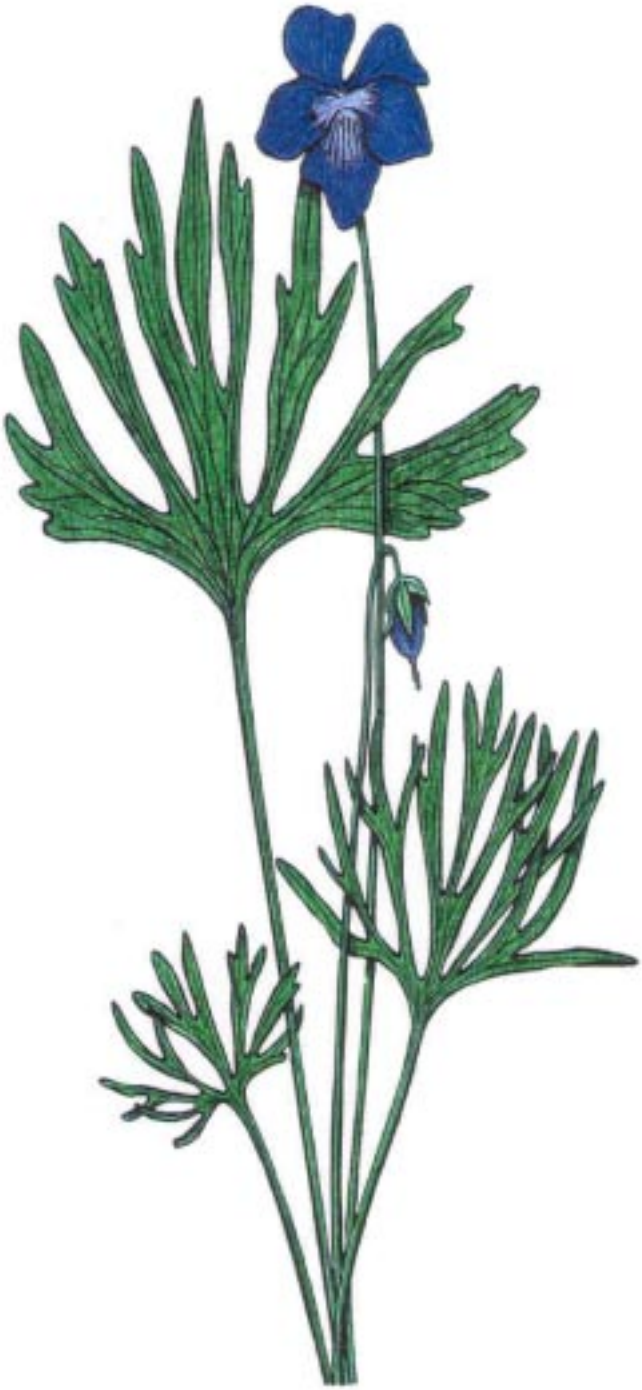


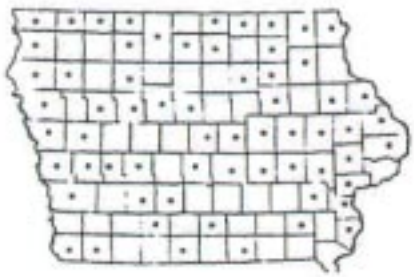
PALE CONEFLOWER
Echinacea pallida
Nutt.

Stem: perennial; basal leaves with a 2′ to 3′ flower stalk; few, long hairs.
Leaves: mostly basal; elongate-oval, blades 7″ by 3 /4″ with leaf stalks from 6″ for basal leaves to 3/4″ for stem leaves; parallel veins in the blades; bulb-based hairs above and below.
Inflorescence: single head at the top of a stalk having stiff hairs and few, small leaves.
Heads: purple, drooping rays, 1 1/2″ long; dark purple disk flowers on a conical base, the disk about I″ tall and I″ in diameter; flowering from mid-June to mid-July; rays often persist until August.
Fruits: "seeds" (fruits) about 1/8″ long, squarish and pointed at one end; no plume; fruiting begins in late June; often fruits persist in the head through the winter.
Habitat: infrequent on dry to mesic prairies; sometimes on little disturbed roadsides and in open places.

PRAIRIE VIOLET
Viola pedatifida
G. Don

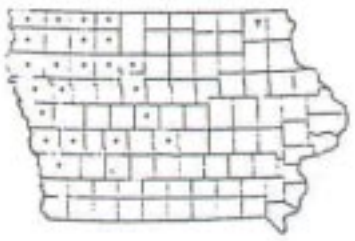
Stem: perennial; very short with basal leaves.
Leaves: basal; deeply lobed into linear segments, each segment again lobed; blades 1 1/4″ by 1 1/2″ and larger; leaf stalks 1″ to 4″ long, smooth; hairs on the margins and veins.
Inflorescence: flowers solitary on smooth flower stalks from the base of plant; open flowers on flower stalks slightly above the leaves; non-opening flowers on shorter flower stalks.
Flowers: petals violet, about 5/8″ to 3/4″ long, with hairs near the base of the lower three petals; sepals 1/4″ long; base of flower curved backward under flower stalk forming a spur containing nectar producing glands; flowering from early to late May.
Fruits: capsule 7/16″ long, opening into three segments; open flowers seldom producing seeds; non-opening flowers on short stalks below the leaves setting fruit through self-pollination; fruiting begins in late May.
Habitat: frequent on mesic to dry prairies; also on moist prairies.





PRAIRIE TURNIP
Pediomelum esculentum (Pursh) Rydb. Psoralea esculenta Pursh

Stem: perennial; 6″ to 12″ tall; branched from the base; densely long-hairy.
Leaves: alternate; palmately compound with five leaflets, elongate-oval; the middle leaflet 1 1/2″ by 1/2“; leaf stalks 1 1/2″ to 2 1/2″ long; leaflets long-hairy below, smooth above.
Inflorescence: racemes at the ends of hairy, upward-curving flower stalks from the lower leaf axils, one to three per plant; racemes I″ to 2 1/2″ long, the flowers crowded; bracts below each flower: very hairy.
Flowers: corolla light blue, 3/4″ long; calyx 5/8″ long, hairy, with long, sharp lobes and stiff marginal hairs: flowering from mid-May to mid-June.
Fruits: one-seeded pod developing within the calyx; tapering to a persistent style 1/4″ long; fruiting begins in early June.
Habitat: common on dry, upland prairies to gravelly prairies and Loess Hills prairies in western Iowa.



PRAIRIE MIMOSA
Illinois bundle flower
Desmianthus illinoensis
(Michx.) MacM.

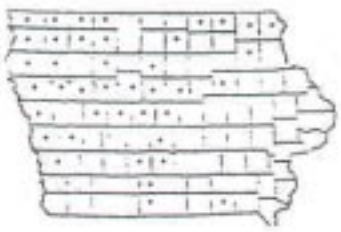
Stem: perennial; 3′ to 4′ tall; somewhat branched; finely hairy on the stem ridges.
Leaves: alternate; twice pinnately compound; 4″ by 3″; nearly sessile; leaflets oval-elongate, 1/8″ by 1/32″; stiff hairs on the margins.
Inflorescence: round heads on short flower stalks at the tips of the branches; up to twenty heads per plant; heads 3/8″ in diameter.
Flowers: corolla white or greenish, inconspicuous, 3 1/16″ long with protruding stamens; calyx 5/8″ long; flowering from mid-July to early August.
Fruits: flat curved pods, 1/2″ by 1/4″, finely hairy, dark brown; clustered in heads 1″ in diameter; fruiting begins in late July.
Habitat: common on Loess Hills prairies and sandy soils in western Iowa, very uncommon on sandy or rocky prairies and waste places in the rest of its range in the state.

DALEA
Dalea
enneandra
Nutt.

Stem: perennial; 2′ to 3′ branching widely above the middle; smooth.
Leaves: alternate, pinnately compound, 1/2″ by 5/16″; usually five or more leaflets, very narrow (3/16″ by 1/32″), black dots on the leaflets and midrib; leaves crowded on robust specimens.
Inflorescence: few-flowered spikes at the ends of the branches, two or three (up to twelve) flowers; spike 1/2″ to 2″ long; each flower attached just above a leafy bract, 1/8″ long with black dots.
Flowers: corolla white, about 3/8″ long, petals spreading; calyx 1/4″ long, with pointed tips, very hairy; flowering from mid-July to mid-August.
Fruits: pod matures within the calyx and does not open; fruiting begins in early August.
Habitat: common on the west-facing Loess Hills prairies in western Iowa.

GROUND PLUM
Astragalus crassicarpus Nutt.

Stem: perennial; sprawling, sometimes 2′ tall; often multistemmed from a common root crown; sparsely hairy.
Leaves: alternate; innately compound; 2 1/2″ by 3/4″; basal leaflets (stipules) round, 1/8″ long; leaflets oval, with rounded bases and tips; 3/8″ by 1/8″; hairy above and below.
Inflorescence: racemes of crowded flowers, 3″ long; from the lower leaf axils; stem growth continues leaving the flowers and fruits near the ground.
Flowers: corolla purple (to whitish); protruding 1/2″ beyond calyx; calyx 1/4″ long, with dark hairs; flowers from early to late May.
Fruits: roundish pod, 3/4″ long by 1/2″ in diameter, smooth; tan and wrinkled at maturity; central membrane divides the pod into two cavities; seeds black, 1/16″ long; fruiting begins in late May.
Habitat: frequent on dry to gravelly prairies and Loess Hills prairies.



LARGE-FLOWERED BEARD-TONGUE

Penstemon grandiflorus Nutt.

Stem: perennial; 2′ to 3′ tall; unbranched; smooth with waxy, bluish cast on stem and leaves.

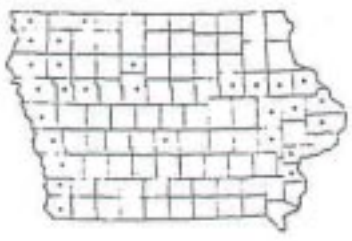
Leaves: opposite; lower round-oval, 2″ by 1 3/8″, upper slightly chordate, I″ x 1″, sessile to somewhat clasping; smooth above and below.

Inflorescence: raceme with two flowers per node; opposite bracts at each node, 5/8″ long, oval.

Flowers: corolla purple to lavender, two-tipped, narrow, funnel-shaped, 1 3/8″ long; calyx five-lobed, 5/16″ long; flowering from late May to mid-June.

Fruits: capsules; 7/8″ long, widest near the base, opening at the tip by four segments; seeds squarish, 3/32″ long; fruiting begins in early June.

Habitat: common on Loess Hills prairies in western Iowa; very infrequent elsewhere on dry, sandy prairies and stabilized sand dunes.



LOCOWEED
Oxytropis lambertii
Pursh

Stem: perennial; very short with basal leaves.
Leaves: basal; pinnately compound, 5″ to 8″ by 2 1/2″; five to seven pairs of leaflets, 1/2″ by 3/16″, tapered to both ends; fine silky hairs above and below.
Inflorescence: up to fifteen flowers in 3″ to 4″ spikes on a hairy flower stalk that extends above the leaves; one to six flower stalks per plant.
Flowers: corolla purple, 3/4″ long; calyx hairy, purple, tubular, 3/8″ long with hair-tipped lobes; flowering from late May to mid-June.
Fruits: inflated pods, 3/4″ long by 1/4″ in diameter, long-tapering to the tips hairy, dark brown; fruiting begins in early June.
Habitat: common on Loess Hills prairies and dry prairies.

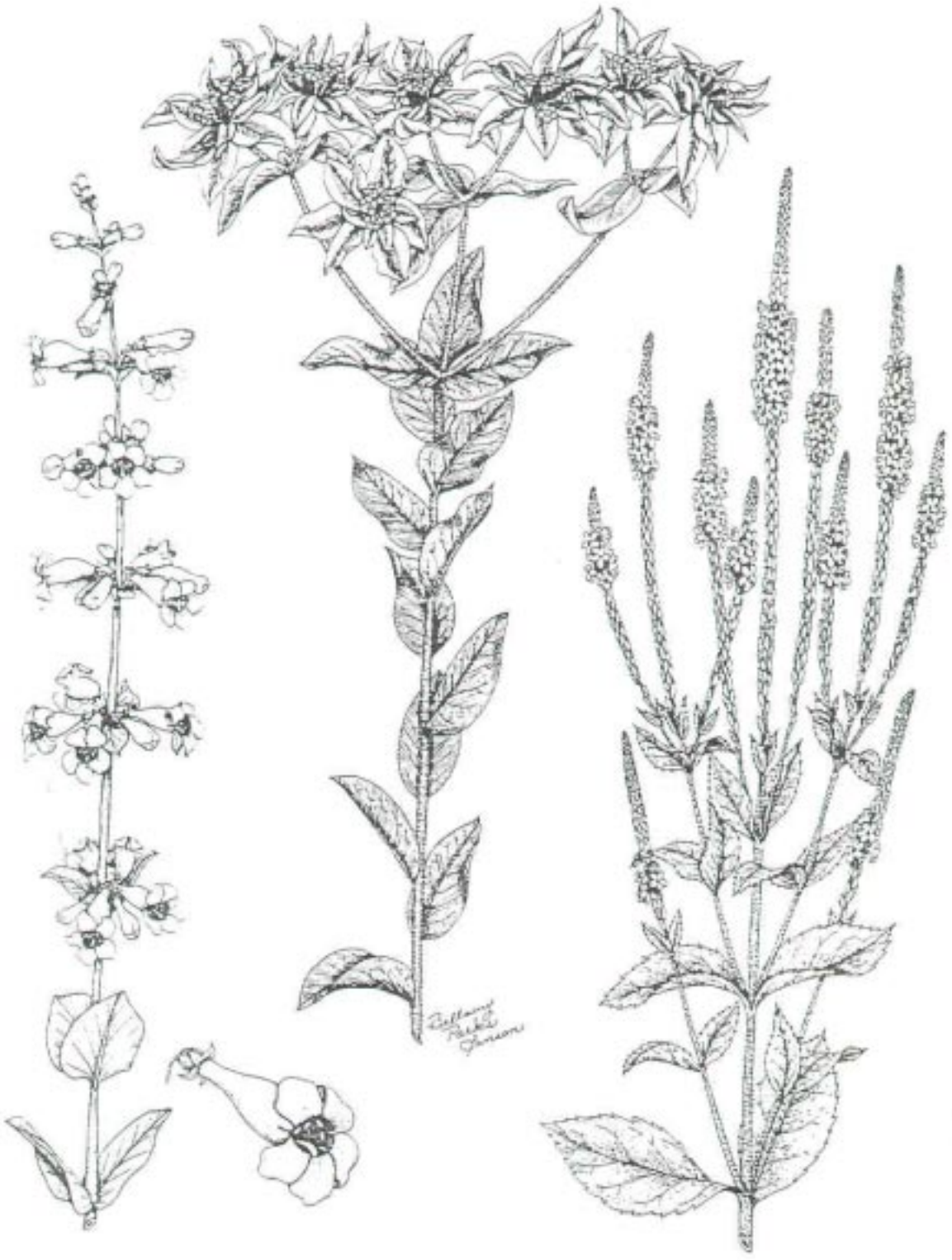
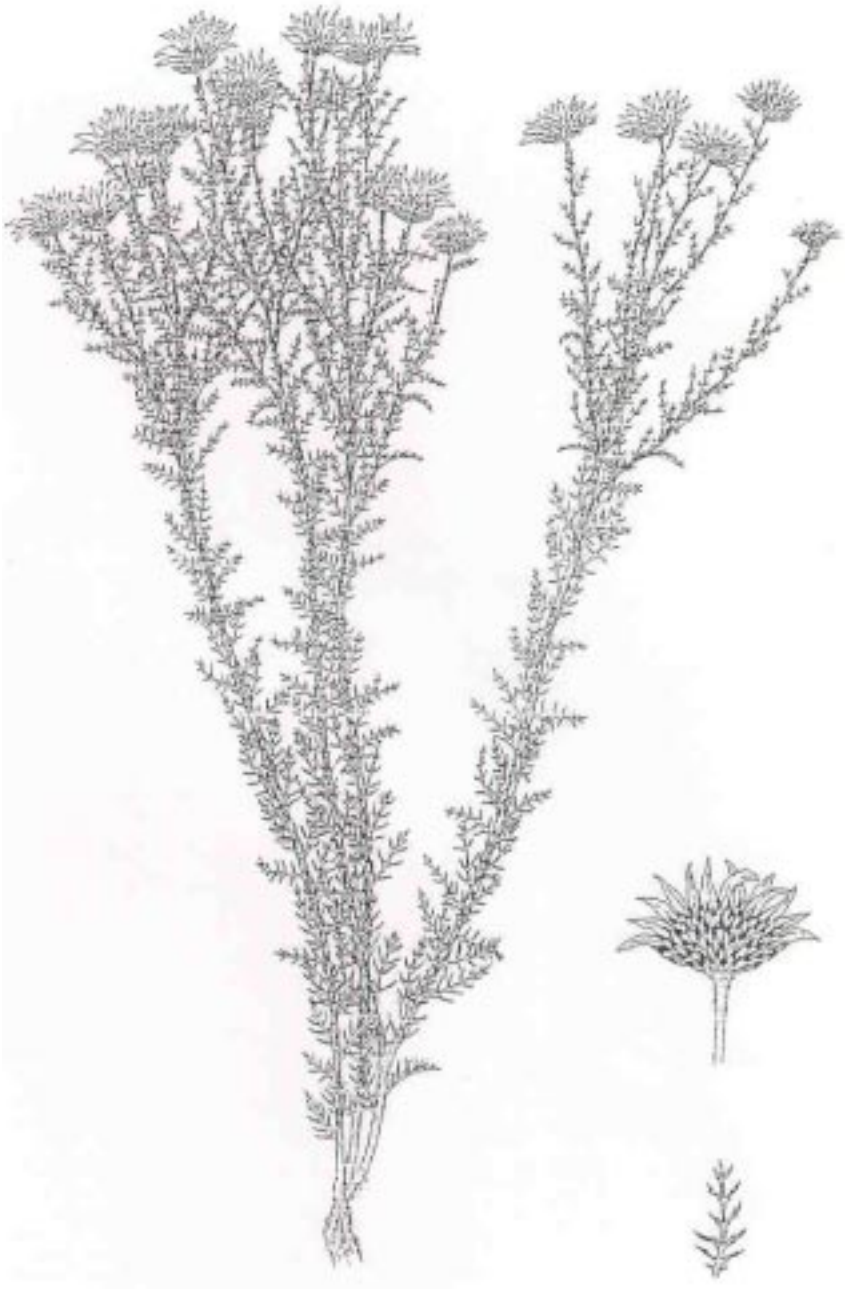


Figure 48. Great-flowered beardtongue (left), snow-on-the-mountain (center), and hoary vervain (right), native species that increase in disturbed areas. Bellamy Parks Jansen.

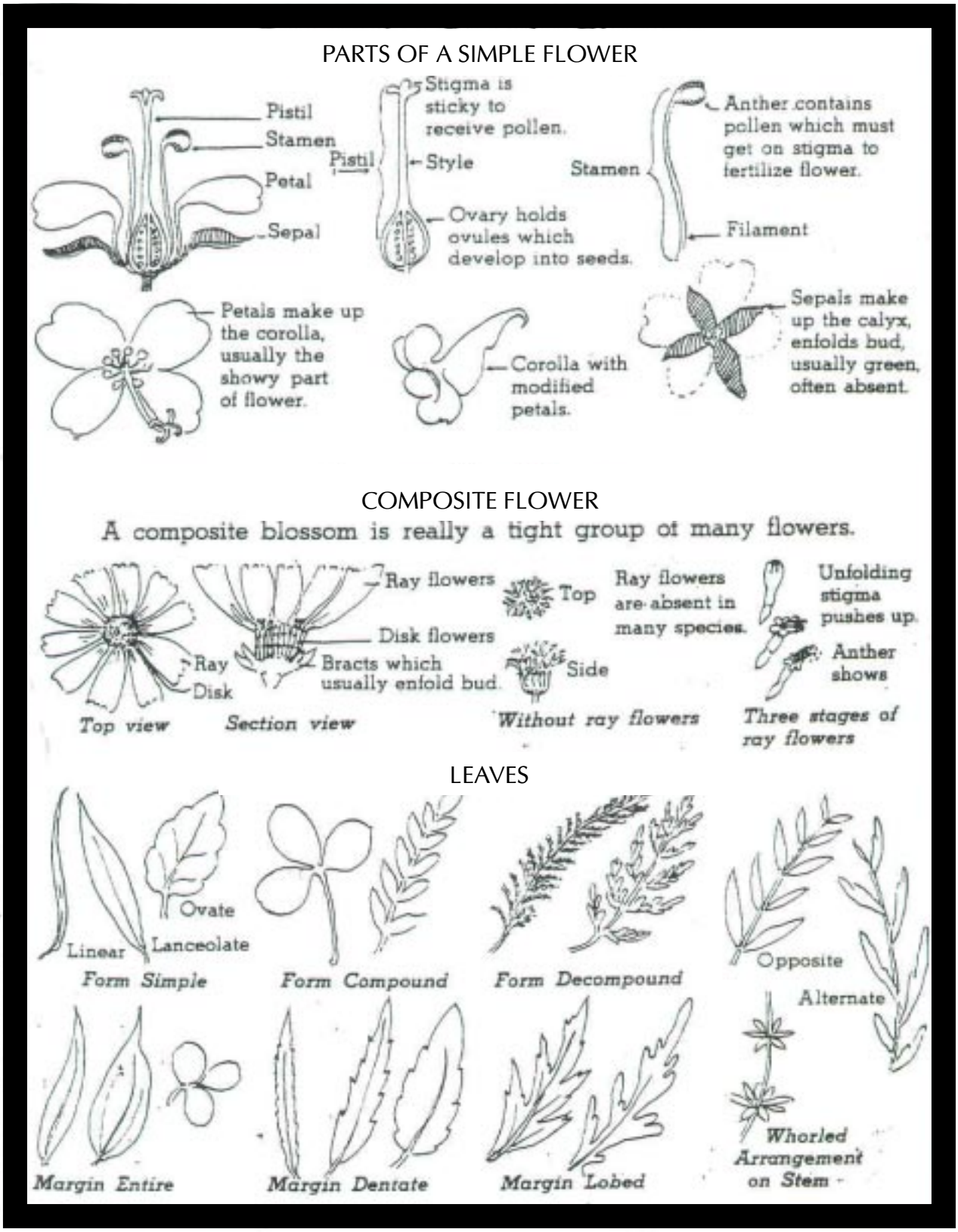
Figure 57. Ten-petal blazing star, a distinctive western species, is on the edge of its range and very rare in the Loess Hills. Bellamy Parks Jansen.

CUT-LEAVED GOLDEN-ROD
Machaeranthera spinulosa Greene Haplopappus spinulosus (Pursh) DC.

Stem: perennial; 1′ to 2′ tall; often several stems from the single root crown; fine, short hairs.
Leaves: alternate; deeply, pinnately lobed; 1″ by 3/8″ overall; tiny chordate bases; few hairs above and below.
Inflorescence: branching flower stalks from stem tip and upper leaf axils; corymbiform.
Heads: yellow rays, 3/8″ long; head 1″ across; yellow disk flowers; fillaries 1/4″ long with a green diamond at the tip; flowering from late June to mid-August.
Fruits: "seeds" (fruits) 3/32″ long, hairy; plumes 1/4″ long; fruiting begins in late July.
Habitat: frequent on dry, rocky prairies and Loess Hills prairies.



Background Information



Amazing Animals

Target Grades: 3 - 5

SUMMARY: Students will learn to classify vertebrates and then apply that knowledge to classify pictures of Loess Hills animals into one of the five classes of vertebrates.

OBJECTIVES: Students will be able to identify the five classes of vertebrates (animals having a backbone and a cranium).
Students will be able to classify pictures of Loess Hills animals into one of the five classes of vertebrates.

GROUP SIZE: Any number

DURATION: Part One, 45 minutes
Part Two, two 45 minute class periods
Extensions, 15-20 minutes each

KEY WORDS: vertebrate, mammals, birds, reptiles, amphibians, fish, environment, ecosystem, habitat, Loess Hills, food chain

STANDARDS: *Science Standards*
Abilities necessary to do scientific inquiry
Characteristics of organisms
Organisms and environments

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

MATERIALS: Student copies of the vertebrate outlines and the drawings of the Loess Hills animals, overhead copies of the five vertebrate pictures, crayons, large sheets of construction paper (one per student), scissors, and glue.

BACKGROUND INFORMATION: The Loess Hills of western Iowa are home to many common animals as well as several rare, endangered and unusual animals. Students' prior knowledge of animals' needs will enhance their understanding of which vertebrates are able to inhabit the Loess Hills area.

Common animals found in the area include: cardinal; eastern bluebird; indigo bunting; eastern meadowlark; cottontail rabbit; ring-necked pheasant; bobwhite quail; white-tailed deer; coyote; fox squirrel; red fox; wild turkey; badger; mink; raccoon; great horned owl; field sparrow; mourning dove; eastern kingbird; blue jay; bank swallow; turkey vulture; prairie ringneck snake; Canada goose; tiger salamander; white-footed mouse; western harvest mouse; prairie deer mouse; prairie vole; bullhead; red-winged blackbird; yellow-headed black bird; great blue heron; great egret; and the red-tailed hawk.

Rare, endangered and unusual animals include: bobcat; Cooper's hawk; grasshopper mouse; plains pocket mouse; thirteen line racerunner; prairie rattlesnake; ornate box turtle; Great Plains skink; Great Plains spade foot toad; and southern bog lemming.

PROCEDURE:

1. Pass out student copies of vertebrate pictures.

2. Define "classification": scientists sort plants, animals, and other things they study into groups according to the similarities (how they are alike) among them. They classify or sort to identify, compare and contrast, and even to identify newly discovered organisms. If necessary, to make this concept concrete to your students, use this activity: Ask for 5 student volunteers to stand in the front of your classroom. Have your students observe how the students are alike and different. Use an overhead, or the blackboard to note the observations (e.g., boys, girls, long-haired, short-haired, glasses, no glasses, tennis shoes, no tennis shoes, buttons, no buttons, etc.). Explain to your students that they have just "classified" like scientists do.

3. Now introduce the term "vertebrate" (animals with backbones and a cranium , a hard-case of bone or cartilage that surrounds the brain). Tell your students that there are five classes of animals that are vertebrates. They are: mammals, fish, birds, reptiles, and amphibians.

4. Next, tell the students that they will learn about each of these classes of vertebrates with you.

5. Starting with the picture of the bird on the overhead, have your students copy the information you share on their copy of the drawing.
   a. Draw a thermometer with a red crayon, to indicate that a bird is warm blooded.
   b. With a brown crayon draw a few feathers and wings on the picture to show that only birds have feathers and wings.
   c. With a blue crayon draw a set of lungs, showing that birds use lungs to breathe.
   d. With a black crayon draw an oval shape to represent the hard-shelled eggs that birds lay.

e. Use a brown crayon to draw a set of legs, and show the hollow bones in each leg. This will allow the children to learn that birds have hollow or partly hollow bones to assist them in flight.
f. Finally, with a yellow crayon, outline the bird with a thin yellow line to show that birds have oil glands which waterproof their feathers.

6. Now place the picture of the reptile on the overhead. Again, have your students copy the information that you share.
   a. Use a blue crayon to draw a thermometer to show that reptiles are cold blooded.
   b. With a brown crayon, draw a few scales on the picture to indicate that reptiles are covered with scales.
   c. With a blue crayon, draw a set of lungs since reptiles breathe with lungs.
   d. Now put the numbers 0 / 4 on the picture. Explain that many reptiles have four legs (with three to five clawed toes), but some have no legs at all.
   e. With a black crayon, draw a wiggly-oval to represent leathery eggs which many reptiles lay.

7. Now place the picture of the mammal on the overhead. Again, have your students copy the information that you share.
   a. With a red crayon draw a red thermometer showing that mammals are warm blooded.
   b. With a brown crayon draw some fur or hair on the picture telling your students that most mammals have hair or fur.
   c. With a blue crayon draw a set of lungs to show that mammals breathe with lungs.
   d. Use a black crayon to draw a little rabbit on the page. Tell your students that mammals give birth to live young.
   e. With a green crayon draw a baby bottle to symbolize that mammals nurse their young with milk.
   f. With a red crayon draw circles on the mammal to represent the oil, sweat, scent and milk glands that mammals have.
   g. With a pink crayon draw a large brain to represent the well-developed brains that mammals have.
   h. With a black crayon draw a few sharply pointed, and a few straight-edged teeth in the rabbit's mouth to show that mammals have different kinds of teeth for eating different kinds of food.

8. Now place the drawing of the fish on the overhead. Ask your students to copy the information that you share.
   a. Use the blue crayon draw a thermometer to show that fish are cold blooded.
   b. With a brown crayon, draw scales on the picture to show that fish have scales.
   c. Use a green crayon to draw a large "C" shape on the side of the fish showing that fish use gills to breathe.
   d. With a brown crayon draw fins on the fish and tell your students that fish have developed fins to help them move the water easily.
   e. With a yellow crayon color in the eye of the fish. Tell your students that fish usually have eyes on the sides of their heads which allow them to see predators more easily while they swim.

f. With a black crayon draw little circles in the space outside of the drawing. These will represent the eggs that fish usually lay in the water.

9. Finally place the picture of the amphibian on the overhead. Ask your students to copy the information that you share on their own copy.
   a. Using a blue crayon draw a thermometer to show that amphibians are cold blooded.
   b. With a red crayon outline the drawing. Tell your students that this will help them to know that amphibians have moist skin.
   c. With a blue crayon draw a set of lungs, a "C" for a gill, and put a line of blue along one of the drawing's edges. Tell your students that amphibians are unique in that some breathe with lungs, some with gills, and some through their skin.
   d. Use a black crayon to write these numbers on the outside of the drawing: 2 / 4. Now tell your students that most amphibians have 4 legs, but a few have only two legs.
   e. Use a black crayon to draw a number of circles that intersect in a corner of the drawing. This will represent the jellylike egg mass that amphibians lay in water.

10. Now let the children know that they will be tested on their new knowledge of the classes of vertebrates through a study of and the classification of Loess Hills animals.

Part Two

1. Hand out copies of the Loess Hills animal drawings, and large (12 x 18) sheets of construction paper (one per student).

2. Have students look at the drawings of the animals and share what knowledge they have about color, size, eating habits, habitat, etc. Have students ask any questions they may have about any of the vertebrate animals. Help students research for information.

3. Give students time to color the animals their appropriate color.

4. Have students divide their construction paper into five areas, and label each with one of the five classes of vertebrates. Next have students cut apart the drawings and place each drawing in the correct animal classification. After a class discussion of where and why the vertebrate animals belong in a specific class, students can glue the pictures in the correct area.

EVALUATION: Evaluate students on responses during the discussion and placement of animal drawings. Or have students sort and paste, and grade the percentage of correct responses. Follow with a discussion so that students will know the correct classification of animals and will not have any misconceptions based on their incorrect answers.

EXTENSIONS:

1. Have the students classify the animal pictures according to the habitats that are found in the Loess Hills area.
   a. River floodplain: bank swallow; snapping turtle; great blue heron; and channel catfish.
   b. Marsh: Canada goose; bluegill; mink; snapping turtle; great blue heron; bullhead; yellow-headed blackbird; southern bog lemming; and the red-winged blackbird.
   c. Prairie: white-footed mouse; prairie vole; cottontail rabbit; prairie deer mouse; bobwhite quail; grasshopper mouse; Great Plains spadefoot toad; Western harvest mouse; ring-necked pheasant; coyote; badger; ornate box turtle; red fox; milk snake; and the Plains pocket mouse.
   d. Woodlands: cardinal; Eastern bluebird, indigo bunting; red-tailed hawk; white-footed mouse; turkey vulture; great horned owl; bobwhite quail; bobcat; wild turkey; squirrel; tiger salamander; white-tailed deer; raccoon; Cooper's hawk; and the mourning dove.

2. Have the students use the animal pictures to create a food chain. The primary producers that are the beginning of the food chain consist of green plants, such as grasses and small plants. The students could draw these plants on their paper and then glue the pictures of the animals that are consumers with arrows to show the path of the food energy.

RESOURCES: See resource section of this curriculum.

White-footed Mouse

Turkey Vulture

Red-tailed Hawk

Prairie Vole

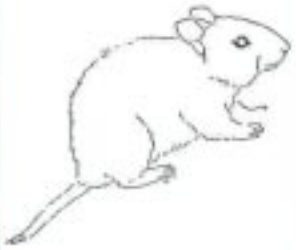
Great Horned Owl

Cottontail Rabbit

Prairie Deer Mouse

Bobwhite Quail

Red-winged Blackbird



Grasshopper Mouse

Southern Bog Lemming

Bank Swallow

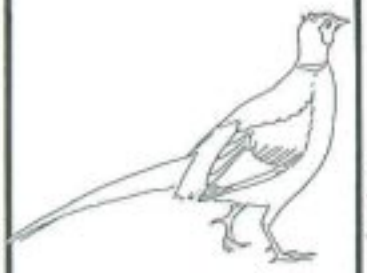
Bobcat

Great Plains Spadefoot Toad

Yellow-headed Blackbird

Western Harvest Mouse

Wild Turkey



Ring-necked Pheasant

Coyote

Mink

Fox Squirrel

Badger

Tiger Salamander

Ornate Box Turtle

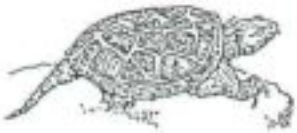
Channel Catfish

White-tailed Deer

Red Fox

Cooper's Hawk

Raccoon



Snapping Turtle

Great Blue Heron

Bullhead

Milk Snake

Canada Goose

Mourning Dove

Pocket Mouse

Cardinal

Eastern Bluebird

Indigo Bunting

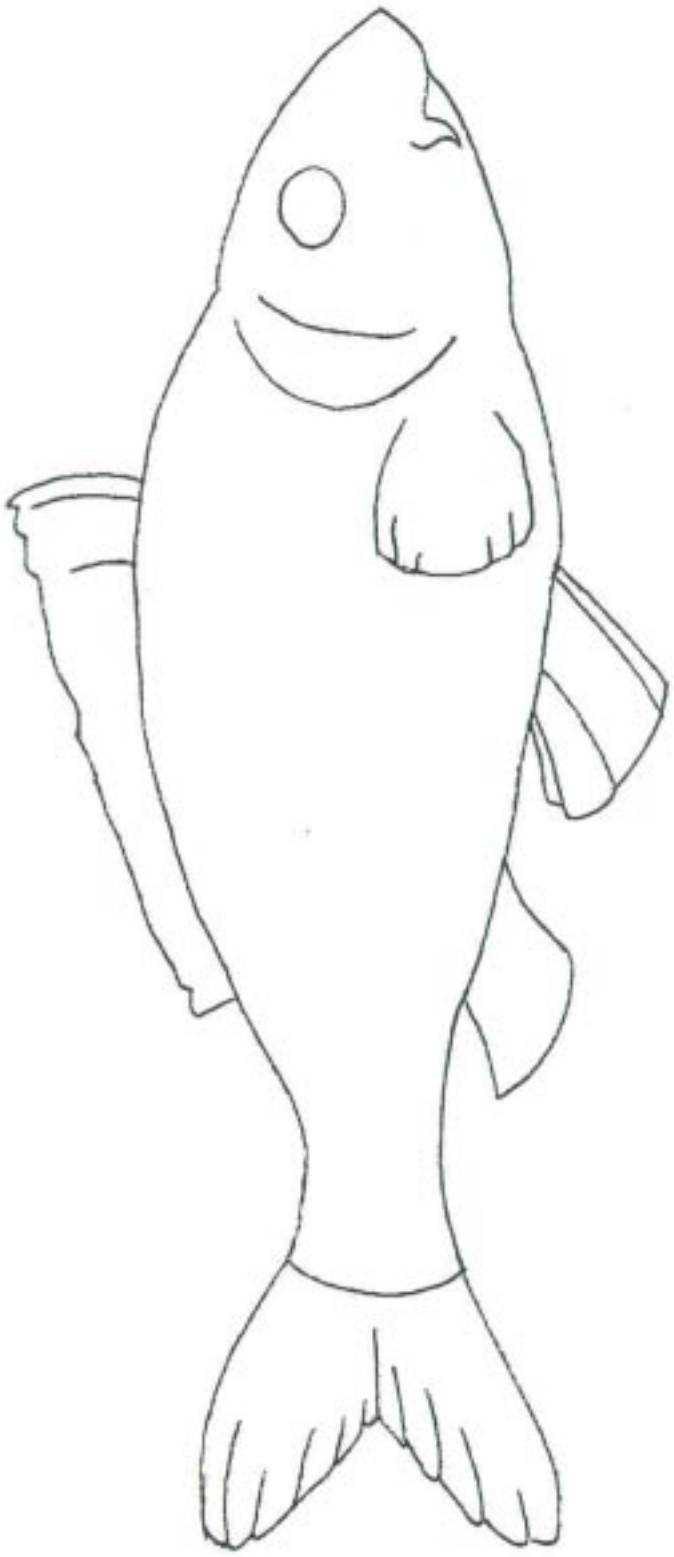
Red-winged Blackbird

Bluegill

Eastern Meadowlark

AMPHIBIAN

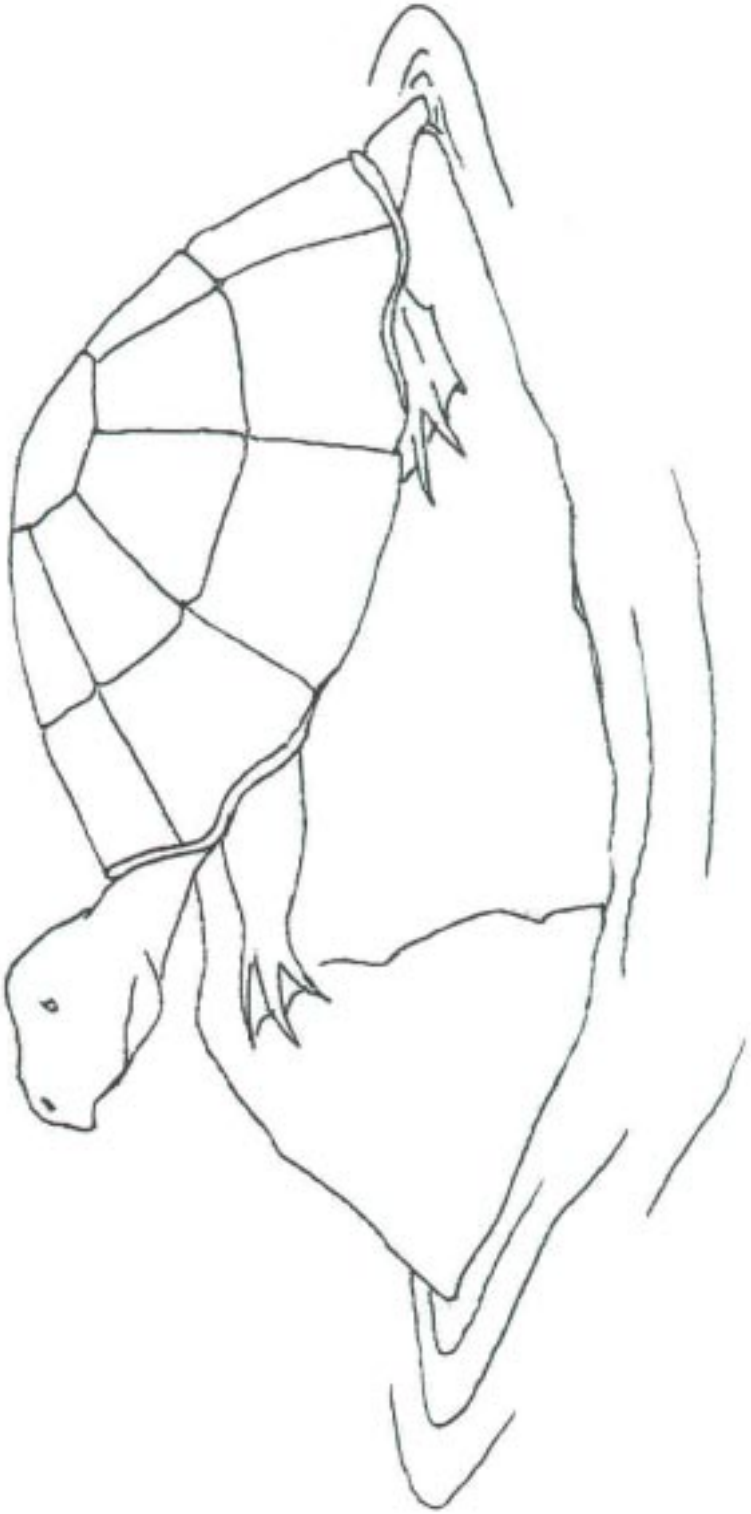
BIRD



FISH

MAMMAL

REPTILE



Prairie Smoke

Target Grades: 6 - 8

SUMMARY: Students listen to legends about prairie plants and then create stories of their own based on observations of characteristics of prairie plants.

OBJECTIVES: Students will become aware of the importance of myths and legends in American Indian culture.
Students will observe characteristics of native prairie plants.
Students will use facts and observations of plants to create stories.

GROUP SIZE: Up to 30

DURATION: 45 minutes

KEY WORDS: myth, herb, plant uses

STANDARDS:

Science Standards
Abilities necessary to do scientific inquiry
Diversity and adaptations of organisms
History of Science

National History Standards
Students should develop an understanding of the biological and cultural processes that shaped the earliest human communities.

National Geography Standards
Understands that culture and experience influence people's perceptions of places and regions.

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

MATERIALS: Plant identification books, paper or journals, pencils

BACKGROUND INFORMATION: American Indians had many uses for and stories about plants. Some of these that relate to prairie species are as follows:

1. A smudge made of Aster blossoms rubbed on the head was said to cure insanity.

2. Members of the Ponca tribe chewed the underground corm of the Blazing Star and then blew the resulting paste into their horses' nostrils to increase the horses' endurance.

3. The Lespedeza or Bush Clover was used as a rheumatism treatment. The Dakota and Omaha moistened the small stems with their mouths and stuck them to the skin. The other end was then set afire and allowed to burn down to the skin.

4. One who had broken a rule or touched a forbidden object could be restored to good standing in some tribes by bathing in water with Prairie Sage in it. Burning sage was also used to drive bad spirits from a home.

5. Big Bluestem was used to cure fever - a cut was made in the forehead of the affected person and a concoction made from leaves was poured over it.

6. White-fringed Orchid (an endangered species in Iowa) was used as a love charm. The Ojibway put it in the food of the intended (although to tell them would be unfair). Potawatomi believed that to rub it on the cheek would help secure a good husband.

7. Purple Coneflower was found to be a burn preventative and enabled one to endure great heat. After bathing hands in the juice of the plant, meat could be picked out of a boiling pot. Sometimes it was used before rituals that required one to hold live coals in the mouth.

Stories About Prairie Plants:

The Pasque Flower Prairie Smoke is a name given by some to the fuzzy Pasque Flower (although another plant is also known as Prairie Smoke). Early in the spring, when the snow has scarcely melted, the prairie is covered with gray-blue flowers that look like smoke hovering over the prairie. The Cree say these are very brave little flowers that arrive while it is still so cold they must wear their fur coats (their stems are hairy).

The Dakota say that long ago whenever any of the people happened to pass by where these flowers were blooming,

the flowers tried to show their friendliness by nodding their heads and showing their smiling faces and saying "Good Morning!" But they passed by unheeding. Nowadays, having been rebuffed by the people but still having friendly feelings, they shyly turn their heads to one side as they nod and call their greetings in a sweet, low voice.

The Prairie Rose

The prairie was gray and drab. No beautiful flowers brightened the dull greenish-gray of the herbs and grasses, and Mother Earth's heart was sad. She sighed and said, I wish my robe were bright and beautiful with flowers and color. I have many sweet, dainty flowers in my heart - I wish to have them on my robe so I will not be sad when I look upon it."

A little pink flower said, "Do not grieve, Mother. I will go upon your robe and beautify it." So the little pink flower came up from the heart of Mother Earth to be upon the sad prairie of her robe.

Now, when the Wind Demon saw the pink flower, he said, "I will not have her trespassing on my playground." So the Wind Demon rushed at her, shouting and roaring, and blew out her life, but her spirit returned to the heart of Mother Earth.

And when the other flowers ventured out, one after each other, to the prairie which was Mother Earth's robe, the Wind Demon destroyed them also, but their spirits returned to the heart of Mother Earth.

At last Prairie Rose offered to go and brighten the appearance of her Mother's robe. Mother said fondly, "Yes, dear child, I will let you go. You are so lovely and your breath is so sweet it may be that the Wind Demon will be charmed by you, and allow you to remain on his ground."

So Prairie Rose made the journey up through the dark ground and came out on the sad, gray prairie. As she was going, Mother Earth said in her heart, "Oh, I hope the Wind Demon will allow her to live, for I wish my robe to be beautiful!"

Now, when the Wind Demon saw Prairie Rose, he rushed at her shouting and said, "Indeed, she is pretty, but I shall not allow her to be on my ground. I will blow out her life." So he came on roaring

and drawing his breath in strong gusts. Just then he caught the fragrance of the breath of Prairie Rose. “Ah”, he said. “How sweet her breath is! I do not have it in my heart to blow out the life of such a beautiful maiden whose breath is so sweet! She shall stay here with me, and I must make my voice gentle and sing a melodious song, for I do not wish to frighten her with my awful noise.” So he became quiet and breathed gentle breezes which passed over the prairie grasses whispering and humming little songs of gladness. Then the other flowers also came up through the dark ground and upon the prairie and made it bright and joyous with their presence. The wind came to love all the flowers and grasses. And so the robe of Mother Earth became beautiful because of the loveliness and sweet breath of the Prairie Rose.

The Sunflower

Once, a long time ago, a company of Dakota men were going upon a war expedition. They were proceeding cautiously, as they were in the country of the enemy. One morning, very early, they heard what seemed to be the sound of someone singing in a tremulous voice, coming from the direction in which they were marching. They stood still to listen.

As they stood listening, it seemed to them that the singer, whoever he may be, must be a clown, for he was singing a clown song. There was not enough light to see the singer, but they waited, silently and anxiously peering in the direction from which came the singing. At the first glimmer of the dawn light they were able to see a man walking with a shuffling awkward gait. His robe was ragged and his leggings drooped down his ankles in wrinkles as he walked. He had circles painted around his eyes in bright yellow, and he was singing a clown song in a husky, wheezy voice.

The men stood wondering at the clown who was coming toward them. He was coming toward the rising sun, and as the daylight grew brighter, they were astonished to see the man suddenly turn into a sunflower. And ever since that time, it is said, the sunflower faces towards the sun.

PROCEDURE:

1. While on the prairie, students should take time to observe the many characteristics of the grasses and flowers. They may want to make notes or sketches to be used later.

2. Some of the unusual or descriptive plant names should be pointed out at this time, as well as some of the legends and uses for the plants as listed in the background information.

3. Discuss why the plants may have been given their names and how students think that they were discovered. (Who would have thought to chew a plant and blow in a horse's nose, for instance?)

4. Either while still on the prairie, or back in the classroom following the visit, students use the information and observations to create stories and/or imaginary uses for some of the plants they have discovered (point out that the Native American uses were generally not imaginary that modern science has found many of the plants have pharmacological properties, and are now the basis for some of our modern medicines).

EVALUATION: Students' work should be shared in class and displayed in the school or printed in booklet form. Specific requirements could include a minimum number of paragraphs and a sketch to illustrate the text.

RESOURCES:

Angier, B. (1974). Field Guide to Edible Wild Plants, Harrisburg, PA: Stackpole Books.

Caduto, M.J. & J. Bruchac. (1994). Keepers of Life Golden, CO: Fulcrum Publishing Company.

Densmore, F. (1974). How Indians Use Wild Plants for Food, Medicine, and Crafts. New York, NY: Dover Publications.

Gilmore, M. (1987). Prairie Smoke St. Paul. MN: Minnesota Historical Society Press.

Kindscher, K. (1992). Medicinal Wild Plants of the Prairie Lawrence, KS: University of Kansas Press.

Peterson, L.A. (1977). Peterson Field Guides: Edible Wild Plants, Boston, MA: Houghton Mifflin Company.

Peterson, R. T. & M. McKenny. (1968). Peterson Field Guides: Wildflowers, Boston, MA: Houghton Mifflin Company.

Roosa, D. & S. Runkel. (1989). Wildflowers of the Tallgrass Prairie. Ames, IA: Iowa State University Press.

CREDIT: This activity was adapted with permission from Project Bluestem, prairie curriculum published by the Neal Smith National Wildlife Refuge and Prairie Learning Center.

The Loess Hills of Western Iowa

Crossword Puzzle Review
Target Grades: 6 - 8

SUMMARY: Students complete a crossword puzzle.

OBJECTIVE: Students will demonstrate their knowledge of the Loess Hills flora and fauna through the completion of this crossword puzzle.

GROUP SIZE: Any number

DURATION: One class period

STANDARDS: *Science Standards*
Structure and function in living things.
Populations and ecosystems.
Diversity and adaptations of organisms.

MATERIALS: Copies of crossword puzzle, and resource materials on the Loess Hills.

PROCEDURE:

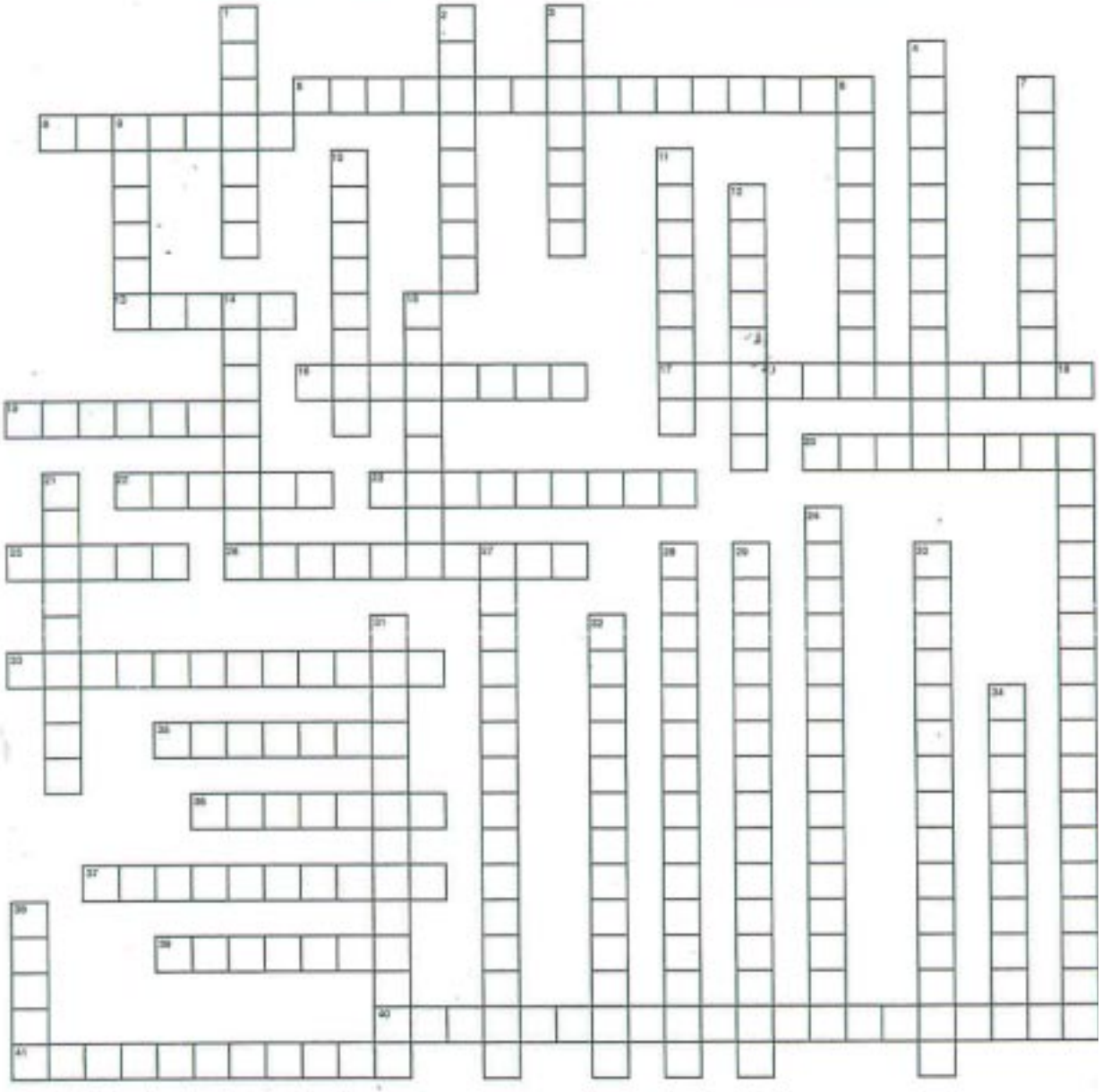
1. Make copies of the crossword puzzle (one per student).

2. If this activity is to be a "discovery" activity, references and answers could be shared in student groups. If the lesson is to be used as a review, or an evaluation of a unit, then students should be instructed to work independently.

EVALUATION: If this is used to introduce the organisms of the Loess Hills, the assessment would be to measure the group's successful completion of the puzzle, and their ability to work together. If the lesson itself is used as an assessment, students would be evaluated on the percentage of correct answers.

CREDIT: This activity has been adapted and is used with permission from Earth Trails: Loess, a multimedia curriculum developed and published by Iowa Public Television's Interactive Media Team.

The Loess Hills of Western Iowa



Across:

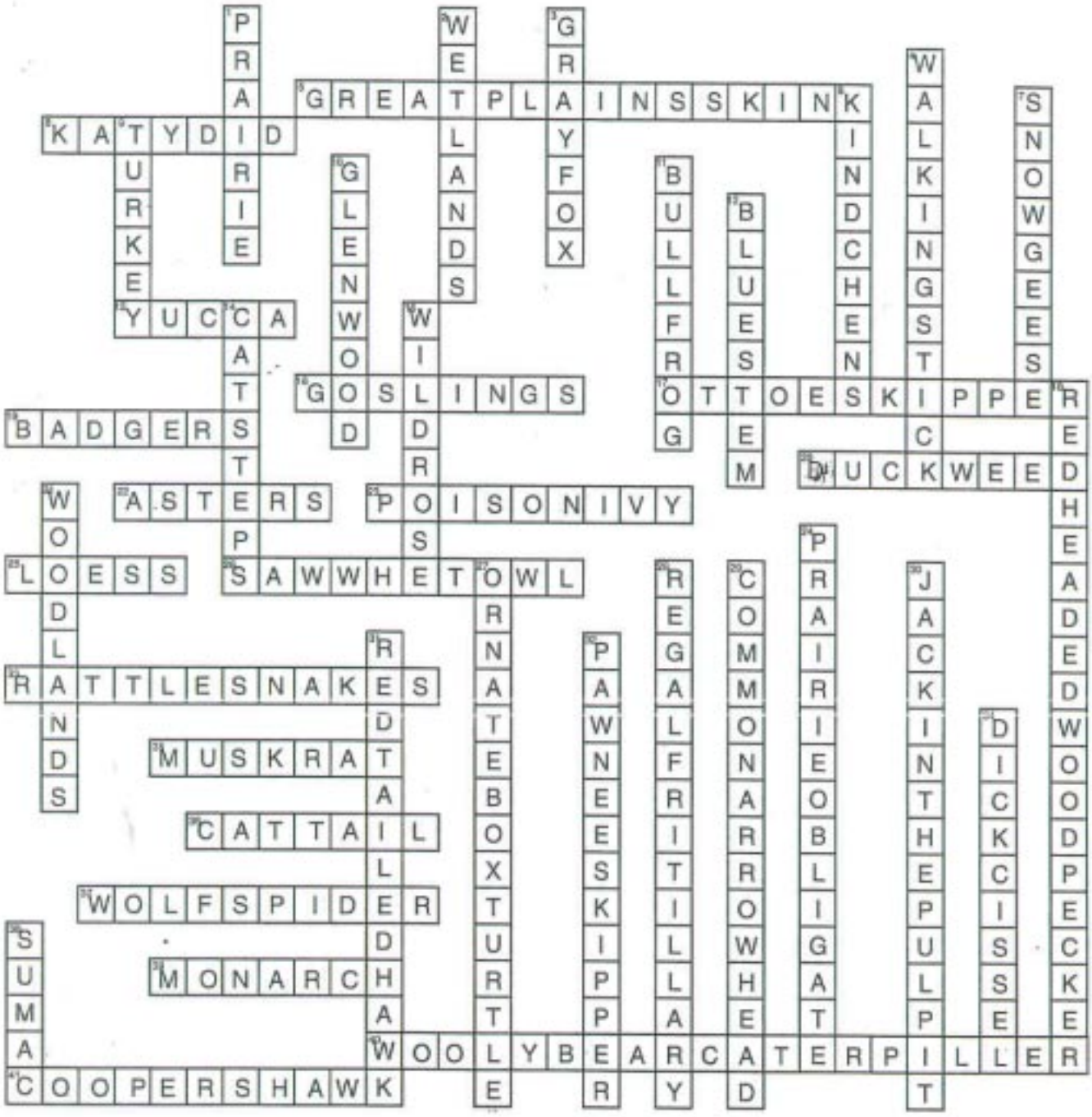
5. A smooth-skinned lizard that resembles a snake.
8. This green insect belongs to a family of insects called long-horned grasshoppers.
13. This is an unusual plant for Iowa because it is normally found in drier western environments.
16. These young water birds which characteristically have a shorter neck than a swan and a shorter, more pointed bill than a duck.
17. This orange and gray butterfly looks like a moth.
19. These top predators pursue rodents by digging after them and, in the process, "till the prairie".
20. Although this water plant may look like green slime or algae, it is really the smallest flowering plant in the world.
22. This is a plant with rose-pink flowers which grows best on dry prairies. The Meskwaki Indians used it for medicine.
23. Although over sixty species are known to use this plant as food, all parts of it, including its white berries, are poisonous to man. The phrase "leaflets of three let it be" help us identify it.

25. These deposits are particles of silt and clay blown by the wind into huge drifts.
26. This robin-sized owl is the smallest of all owls.
33. This prairie species is among the most endangered of all organisms in Iowa. Their distinctive rattle warns enemies not to come any closer.
35. This wetland mammal builds a lodge of mounded vegetation in a shallow pond or burrows into the sides of earthen banks.
36. This wetland plant looks like a brown corncob stuck on the end of a stem.
37. A ground-dwelling spider, it often captures prey by chasing them down and killing them with poison fangs. It does not build a web even though it could.
39. This is a nasty tasting butterfly which migrates to Mexico in the Fall.
40. This is the larvae of the Isabella tiger moth.
41. This is a small hawk with reddish-brown and white streaking on its front.

Down:

1. This is an area dominated by grasses with few shrubs or trees.
2. This is an area dominated by marshes and shallow ponds. The soil is saturated with water for at least several weeks during the year.
3. This secretive animal has dens in a hollow log or burrow when raising its pups. It is the only member of the dog family that can climb up the branches of a tree to escape its enemies.
4. This insect is a "master of deception" with its adaption called crypsis.
6. These pieces of rock-like material form in the loess as calcium carbonates, collect and build up into a ball.
7. This wetlands bird has black wing tips. The rest of it can be either as white as snow or bluish-gray.
9. Ben Franklin preferred this bird to the bald eagle for our nation's bird.
10. This community in western Iowa gave its name to the unknown group of people who lived near there around a thousand years ago.
11. This is the "boss" of the frog world.
12. "Big" or "little" these grasses dominate the prairie.
14. This unusual geological feature of the Loess Hills resembles natural terraces. Some people believe that they were formed by grazing animals, while other people believe it is the result of erosion.
15. The state flower of Iowa, this plant has both beautiful blossoms and thorns.
18. Although it does drill holes in trees to store such food as seeds and nuts, this woodland bird usually forages for food by searching the ground for beetles, ants, and spiders.
21. There are two basic types of this area, the upland forests and the bottom land forests.
24. Any organism that must have the prairie to survive qualifies to carry this name.
27. A rare resident of the prairies and plains who, unlike its cousins, prefers burrows to ponds, this critter could actually drown in too much water.
28. This orange and black butterfly looks much like the Monarch.
29. A plant of shallow wetlands, it gets its name from its spear-shaped leaves.
30. This forest flower blooms between late April and early June. By late summer, it produces a cluster of red berries.
31. This high flying bird is best known for its high, piercing scream. It is the most common of its species in North America and has eyesight eight times sharper than a human.
32. This is another orange-gray butterfly that is also a prairie obligate. It got its name from a group of Native Americans that also lived on the prairie.
34. This sparrow-like bird nests on the ground in prairies, meadows, and hayfields.
38. This plant provides brilliant autumn color with its reddish leaves.

The Loess Hills of Western Iowa



Looking at Loess: Soil Composition

Target Grades: 6 - 8

SUMMARY: Students will compare loess soil to other soil samples to learn the composition of soils.

OBJECTIVES: Students will use loess soil and another soil (a good garden soil mix) to discover that soils may be made up of sand, silt, and clay.

Students will understand that soils may be separated into soil components because of particulate size.

Students will discover that loess soil is comprised primarily of silt sized particles.

GROUP SIZE: 20-30 students divided into groups of two

DURATION: Three 45 minute class periods

KEY WORDS: loess, sand, silt, clay, humus, and organic matter.

STANDARDS: *Science Standards*
Abilities necessary to do scientific inquiry
Understands about scientific inquiry

National Mathematics Curriculum
In grades 5 - 8 the mathematics curriculum should include the investigation of mathematical connections so that students can apply mathematical thinking and modeling to solve problems that arise from other disciplines, such as art, music, psychology, science and business.

MATERIALS: 500 ml graduated cylinders, dry loess soil (taken from various levels of a road cut in the loess hills- label each container with the sample's location), dry soil samples taken from various other locations, pestle and mortars, water, alum, scales/balances, 400 ml beakers, paper towels, distilled water, stirring sticks, microscope, and hand lenses.
**See OPTION - this will provide a simplified list of materials.

BACKGROUND INFORMATION:

Soil may be separated into its three major components because of particulate size. In this experiment, students will add water and alum to soil samples to determine the composition of the sample. Results will prove that sand has the greatest particulate size; therefore it will end up as the bottom layer. Silt is the second largest, and will end up in the middle layer. Clay is the smallest of the three, and will be the top layer, possibly suspended, in a soil column. Organic matter will float on water and will not be a major topic of discussion in this lesson. Percentages of each component determine the soil type.

This experiment will compare loess soil to other soils. Loess soil mainly consists of fine-grained cohesive quartz silt. It is considered to be a homogeneous material, although loess soil may contain small calcium carbonate "rocks" called kindchens, which means "little ones" or "small children" in German. Kindchens are formed when water dissolves small grains of calcium carbonate (lime). This water mixture moves the dissolved carbonate downward into a crevice or hole. The calcium carbonate then separates out and hardens, forming the concretions, or rocklike bodies. Kindchens may be irregular in shape and will fizz when hydrochloric acid is dropped on them. Vinegar will also yield a reaction, although not as dramatic as the reaction caused by hydrochloric acid. Since loess is a homogeneous material, the students should discover that the loess sample consists of only one particulate size - silt.

Loess soil originated as an outwash material released by glacial melting that occurred north of the Loess Hills region. The last two glacial advances which occurred during the Illinoian period - approximately 130,000 to 150,000 years ago - and the Wisconsin period- approximately 18,000 years ago - are responsible for the major deposits of loess in the Loess Hills region. This outwash material, was deposited in what is now known as the Missouri River Valley. It was then picked up and blown to the east by the westerly winds. The heavier material formed the hills much like a snow drift is formed. Glacial till from what is collectively called the Pre-Illinoian era (dating back to 2.1 million years) is also visible in road cuts. Since the glacial till deposits contain rocks, the loess layers are easily identifiable because they do not contain rocks. At the Monona/ Harrison county line a layer of ash is visible. It has been dated to approximately 600,000 years before the present. Other ash layers can be found elsewhere throughout the Loess Hills and date from 600,000 to 2 million years ago. Their origin is believed to be from now-extinct volcanoes located in Yellowstone National Park, Wyoming.

PROCEDURE:

1. Discuss vocabulary and soil samples.

2. Divide students into groups of two.

3. Students will be given soil and instructed to crush any large chunks of soils with the pestle and mortar. All large rocks should be removed from the soil sample.

4. Students should then calibrate the balance and find the mass of a paper towel.

5. Students will measure out 150 g of the finely crushed soil.

6. Students will mix 250 ml of distilled water and two teaspoons of alum together in a 400 ml beaker. Stir until dissolved.

7. Students will add the 150 g of crushed soil to the water mixture and stir for five to ten minutes.

8. Students will pour the soil/water mixture into 500 ml graduated cylinders, making sure to get all of the soil out of the beaker into the cylinder. If necessary, the students may add up to 50 ml of water to rinse the cylinder. The ending mark on the cylinder should be 400 ml.

9. Capping the end tightly with one hand, students should shake the cylinder vigorously for 1 to 2 minutes.

10. The cylinder should be left to sit undisturbed for 24 hours.

11. Students will repeat steps 3 -10 using a second sample on Day 2.

12. Students will record the procedures followed and how each step was accomplished in their notebooks. The students should be precise.

13. Students will also record comparisons that they make about the two soil samples. For example, students may record that the loess soil had no sand-sized particles and that the other sample did. Other areas to compare include the color of the soil, the length of time it took for the samples to separate, and the amount of organic matter each had. Hand lenses and microscopes may be used to assist in the comparisons.

Discussion Day 1:

1. Review vocabulary.

2. Review soil experiment procedures.

3. Address concerns about procedures.

4. Remind students to be specific and detailed in observation recordings.

Discussion Day 2:

1. Review vocabulary.

2. Review soil experiment procedures.

3. Address concerns about procedures.

4. Remind students to be specific and detailed in observation recordings.

Discussion questions Day 3:

1. Do you notice any similarities or differences between your two soil samples? Is there any organic material present?

2. What do you think happened to your soil and water mixture? Why do you think that this happened?

3. Why do you think we added alum to the water? (Alum acts as a dispersing agent and assists in the separation of the soil particles.)

4. What difficulties did you experience in this experiment?

5. Calculate the percentage of sand, silt, and clay in the two cylinders. Organic matter will not be calculated at this time.) Calculate the amount of the three particle sizes by measuring each layer in centimeters and dividing that number by the entire depth of the settled soil. Example:

sand:	2cm	=0.1667 x 100
settled soil:	12cm	or approximately 17% sand
silt:	8cm	=0.6667 x 100
settled soil:	12 cm	or approximately 67% sift
clay:	2cm	=0.1667 x 100
settled soil	12cm	or approximately 17% clay

*OPTION
Since the amount of soil and water is NOT a crucial determining factor of the particles, a simpler method may be used. Soil and water can be mixed in a jar so as to create a watery mixture. Students may shake the jar to mix the soil and water. The jar's contents may then be allowed to settle out. The students can also compare and contrast two different soil

types and record their observations as described in the original lesson. This simpler method will eliminate the need for beakers, graduated cylinders, and balances. While this will eliminate the use of measuring skills, the objectives will still be met.

EVALUATION: Students will be evaluated on the thoroughness of their notes and written observations. Notes should be accurate, comprehensive and detailed. Math problems should be present and accurately calculated. Comparisons should be listed in an organized manner.

EXTENSIONS:

1. Invite a soils expert from the Natural Resource Conservation Service (NRCS - formerly the Soil Conservation Service - SCS) to visit your students and discuss soils and their properties.

2. Have students bring soil samples from different locations. Run a soil test on the samples and compare the new soils to the first two samples. Devise a chart and post results of the percentages of sand, silt, and clay contained in each sample.

VOCABULARY:

Loess - The deposited wind-blown silt gathered from a dry riverbed or glacial lakebed.

Sand - Large, gritty minerals resistant to weathering.

Silt - Smooth, much smaller sized particles than sand; slightly slippery, fine textured particles.

Clay - Smallest sized soil particles; particles are very porous; slippery; extremely active chemically.

Humus - A stable and long lasting material formed from the decomposition or organic matter. Humus improves soil by providing aeration.

Organic Matter - Dead and living plant and animal matter.

Fire On the Prairie

Target Grades: 6 - 8

SUMMARY: Through research, and possibly a field trip, students gather information with which they'll identify the possible positive and negative impacts of fire on the Loess Hills prairies (or a prairie area in their locale).

OBJECTIVE: Students will be able to identify and evaluate some positive and negative effects on plant and animal life that result from grassland fires.

GROUP SIZE: Any number

DURATION: Three or four 45 minute periods, longer if field trip is taken

KEY WORDS: droughts, climate, fire suppression, and prescribed burns.

STANDARDS:

Science Standards
Abilities necessary to do scientific inquiry
Change, constancy and measurement

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e g., for learning, enjoyment, persuasion, and the exchange of information).

National History Standards
Students should develop an understanding of the biological and cultural processes that shaped the earliest communities.

National Geography Standards
Understands the physical and human characteristics of place
Understands how human actions modify the physical environment.

MATERIALS: Soil analysis equipment (e.g., pH testing paper), containers for soil samples, plant and animal identification guides for field work, or classroom speaker, or access to library and other reference materials.

BACKGROUND INFORMATION:

Fire has played a significant role in the development of vegetation in North America where periodic droughts, high temperatures and strong wind provide an ideal environment for ignition and perpetuation of fire. (Fire, naturally, is a product of lightning during thunderstorm activity.) Prairies require an occasional fire to maintain a healthy community for both the plants and the many prairie dependent animals.

A significant interest in grassland ecology was stimulated by the pioneering American ecologist Frederick Clements and his student, John Weaver. Weaver, in particular (Weaver, 1954, 1961, 1968, Weaver and Fitzpatrick, 1934) provided detailed descriptions of grassland vegetation in response to grazing and drought. Because much of his work focused on the effects of the drought during the 1930's, Weaver treated fire as a rare and detrimental component of the grassland environment. Fire suppression, therefore, became a primary management tool.

In managing public lands, government agencies for many years have been making a slow movement to change their attitude towards grassland and forest fires. Whereas once all fires were suppressed or vigorously fought, some now are allowed to burn as part of a natural cycle within grassland ecosystems.

Prairie fires, the impact that grazing large mammals had on the prairies, prairie and woodland invasive plants, and climate are all factors that contributed to the original vegetation in the Loess Hills.

When a resource manager plans to burn a prairie it is usually designed to reduce the fuel load in the area. Reducing the fuel load in an area, for example can prevent fires from getting so hot that they eliminate virtually all life forms and even scorch the soil.

Students may ask why - if some fires are helpful- the U.S. Forest Service symbol of "Smokey the Bear" says, "Only you can prevent forest fires." This message is aimed at humans causing fires by error and accidents, from carelessness in camping situations. The message also warns us about the terrible destructiveness of intentional fires set by people for malicious and mischievous purposes. Again, the only people who may be authorized to set prescribed grassland fires are those who are fully qualified professionals, trained in the study of ecological systems to reinstate fire as a natural management tool.

Fires can have negative as well as positive effects. If a fire is too large, too fast, and too hot - wildlife can't easily move to safety. Individual animals may die. Short-term and long-term vegetation loss can have a variety of effects, including impact on wildlife, and an increase in silting and sedimentation in the waters.

There are, however, benefits - particularly in the case of those smaller burns that do not get exceedingly hot.

For example grassland fires can:
- maintain and enhance fire-dependent habitats such as prairies and savannas.
- increase soil productivity by releasing and recycling nutrients tied up in litter and undergrowth.
- prepare soil for germination of some seeds.
- contribute an "edge effect", providing a greater variety of food and shelter sources for wildlife.
- open up habitat, generating new growth, diversity, and abundance of food plants, e.g., for large herbivores.
- trigger germination in certain seeds that require fire to germinate.

PROCEDURE:

1. Begin this activity with a discussion of grassland fires. Students' reactions may be negative at first; point out that while one harmful effect of the grassland fires is their destruction of habitat and killing wildlife, it is also true that such fires improve the habitat and the long-term well-being of wildlife.

2. Brainstorm possible positive and negative consequences of grassland fires for wildlife. Specify kinds of wildlife and give examples.

3. Take a field trip to a prairie where it is possible to see areas that have recently been burned, areas burned ten or more years ago, and areas not burned in recorded history. Try to arrange to go with an ecologist or wildlife biologist who can point out and explain some of the similarities and differences among the various areas. (NOTE: If such a trip is not possible, contact a state wildlife agency, soil conservation district representative, or other resource person for information on the subject. If neither the field trip nor the visit from the resource person is possible, the students will need to work from library and other reference materials on their own.)

4. If the field trip is possible, prepare students to: a) make and record their observations, e.g., variety and quantity of vegetation, evidence of wildlife, actual sighting of wildlife; and, b) with permission of landowner, take small soil samples in the various areas for testing purposes. Back in class, these soil samples should be tested for structure, organic and inorganic parts, chemical composition, etc.

5. Ask the students to organize and present the findings of their research. For example, they could chart information including the following: soil data, plant species, associated wildlife/evidence of wildlife and wildlife observed for each of the areas (i.e., recent fire area, fire 11 years ago, and no recorded fire).

EVALUATION: Ask the students to summarize their findings, including short-term and long-term effects to wildlife in each area, both positive and negative. They would include in their summary an assessment of the importance of fire in natural systems, as well as its effectiveness as a management tool. Ask the students to address any limitations to their study; that is, any aspects of their research which prevent them from generalizing their findings to all fires affecting wildlife.

Also discuss other impacts from wild and controlled burns. What is the public attitude toward fires in forest and grassland areas? What is the broad range of consequences of fires, and the lack of fires on local economy, on aesthetic value, ecological value, agricultural value? You may want to focus on prescribed burns in agricultural areas such restored prairies or roadsides. What are the trade-offs in allowing and preventing fires? For example:

EXTENSIONS:

1. Have your students come up with a set of recommendations for conditions under which fires should be allowed, and when not. Check your recommendations against present guidelines used by the National Park Service (U.S. Department of Interior), and state wildlife agency.

2. Find out about the history of fire management in the U.S. Contrast policies of Native American people and federal agencies. Compare public attitude toward grassland fires today with attitudes during the 1930s and 1940s.

RESOURCES:

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Weaver, J. E. (1954). North American Prairie. Lincoln, NE: University of Nebraska Press.

Weaver, J.E. (1961). "The Living Network in Prairie Soils', Botanical Gazette 123:16-28.

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CREDIT: This activity was adapted with permission from "Fire Ecologies", from Iowa State University Extension's Piecing Together a Habitat Puzzle.

Where in History are the Loess Hills?

Target Grades: 6 - 8

SUMMARY: By making a timeline, students compare the age of the Loess Hills to other biological, climatic and geological events.

OBJECTIVES: The students will demonstrate that in the history of the earth, the Loess Hills are a very "new" formation. The students will develop a scale to use to make a timeline to show the chronology of biological, climatic, and geologic events.

GROUP SIZE: Any number

DURATION: Two to four class periods

KEY WORDS: loess, scale, era, epoch, Precambrian, Paleozoic, and Mesozoic.

STANDARDS:

Science Standards
Earth's history
Systems, order and organization
Change, constancy, and measurement

National History Standards
Students should develop an understanding and the knowledge of how to analyze chronological relationships and patterns.

National Geography Standards
Understands how physical systems affect human systems.

Standards for the English Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

MATERIALS: Copies of handout "History of Earth", one per student. One set of the climate, biology and geology cards. Lightweight rope, and string for hanging events on timeline.

BACKGROUND INFORMATION:

Precambrian Era: includes 80% of the total earth's history, yet for the first 1 - 1 1/2 billion years there is no translatable geologic record. The Earth's crust had not developed sufficiently to become permanent until about 3.5 billion years ago. Scientists acknowledge that the Precambrian record is far more obscure than that for subsequent time. This is due to the fact that many of these rocks are severely deformed, metamorphosed and deeply eroded. Overwhelmingly, the most important single characteristic of the Precambrian time is its lack of "index fossils" (those that are particularly useful for correlation of strata).

Paleozoic Era: "Age of Invertebrates". Marine fossils of seaweed, early fish and invertebrates such as snails, brachiopods, etc. are commonly found from this era. Amphibians, reptiles, plants, forests, and corals became abundant during this era. It lasted from 570 to 250 million years ago.

Mesozoic Era: "Age of Reptiles". This was the time when the first birds and mammals appeared. It was the time of the dinosaurs. The Triassic, Jurassic and Cretaceous Periods make up this era. It occurred from 250 to 65 million years ago,

Cenozoic Era: "Age of Mammals". This era began after the dinosaurs died out, from 65 million years ago to the present.

Epochs- subdivisions of periods on the geologic time scale

Iowa has a unique land form that parallels its western border. (The Loess Hills are a very recent formation on the earth's crust when considering the history of our planet.)

The western boundary of the Loess Hills is very abrupt, going from the flat Missouri River valley to steep western slopes of the hills that are 90 to 200 feet above the valley floor. The eastern boundary is not as obvious. On the eastern side the Loess Hills gradually blend with the more rolling landscape of the Southern Iowa Drift plain.

The Loess Hills vary in width from 3 to 20 miles. The Hills have a corrugated appearance of alternating waves and troughs. From the air the hills have an appearance of snowdrifts and are in fact, dirt drifts created by the wind. When first deposited, the loess was smooth like a sand dune. Today they are rough and jagged with ridges, spurs and valleys. The ridges are hilltops that vary in length and direction. The spurs are usually shorter than the ridges and often slope downhill and end at the valley floor. The valleys divide the ridges and were formed by water draining off the hills.

PROCEDURE:

1. Distribute handout and discuss eras, epochs, and Loess Hills development. Be certain that students know what a timeline is, and have the math skills necessary to figure lengths for different periods. (Hint: if you cut a 45 foot long string, the Precambrian Era will be 39 ft long, the Paleozoic Era will be 3 ft long, the Mesozoic Era will be 2 ft long, and the Cenozoic Era will be I ft long.)

2. Determine a place to display your time line.

3. Divide your class into teams, pass out the event cards and have each team take turns asking the class where their events will be placed on the timeline. (If time is a factor, you may choose to cut down the number of cards used.) Following the question/answer/display of the event cards, have your students then examine their handout and compare the events that lead to Iowa's geologic development with those already discussed. (Students should develop the concept that in the history of the earth, the Loess Hills are a very "new" formation.)

EVALUATION: Students are evaluated on the correctness of their math calculations for scale and their measurement skills when placing events on the timeline.

RESOURCES:

Mutel, Cornelia & Mary Swander. (1994). Land of the Fragile Giants. Iowa City, IA: University of Iowa Press.

Prior, Jean C. (1991). Landforms of Iowa Iowa City, IA: University of Iowa Press.

Shimer, John. (1972). Field Guide to Landforms in the United States. New York, NY: The MacMillan Company.

Troeger, Jack Clayton. (1983). From Rift to Drift: Iowa's Story in Stone. Ames, IA: Iowa State University Press.

History of Earth
Iowa Geological Development

Time	Era/Epoch and Geologic Processes	Scale Size
Present	Loess Hills shaped by erosion	
3,500 ya	Gully cutting filling creates today's Loess Hills landscape	
10,000 ya	Beginning of Holocene Epoch (time since last major Ice Age)	
10,500 ya	Short periods of erosion and sedimentation begin changing the Loess Hills landscape	
11,000 ya	Loess deposition terminates in western Iowa	
12,500 ya 25,000 ya }	Peoria Loess deposited	
25,000 ya 31,000 ya }	Pisgah Loess deposited	
120,000 ya 150,000 ya }	Loveland Loess deposited	
1 mya	Glaciers cover central U.S. (Iowa). Flatten land and leave till deposits	
2.5 mya	Continental ice sheets advance into Iowa	
65 mya	BEGINNING OF CENOZOIC ERA	
130 mya	Bedrock found in northern Loess hills formed	
135 mya	North American continent slowly drifts north, closer to present location	
145 mya	Fort Dodge Formation: one of the purest gypsum deposits known on Earth.	
230 mya	BEGINNING OF MESOZOIC ERA	
300 mya	Coal swamps: coal deposits formed. Some coal swamps in central and southeastern Iowa.	
500 mya	Iowa under warm shallow sea. West coast of North America runs east and west along the equator.	
570 mya	BEGINNING OF PALEOZOIC ERA	
	PRECAMBRIAN ERA ⩛⩛⩛⩛⩛	

ya=years ago
mya=million years ago

1. When was oxygen first evident on Earth?

Climate Events

2. What was the Earth's first atmosphere like?

Climate Events

3. When did the water vapor in the atmosphere first begin to condense into water and clouds?

Climate Events

4. When did the first ice age occur?

Climate Events

5. When did the ozone first appear in Earth's atmosphere?

Climate Events

6. Were there other ice ages during the Precambrian Era?

Climate Events

7. After the initial warm phase of the early Earth, were there other warm periods?

Climate Events

8. Were there any ice ages in the Paleozoic Era?

Climate Events

The Earth's atmosphere was originally composed primarily of water vapor and CO2 about 4.5 bya. (Pre)

Oxygen first appeared about 1.8 bya as a by-product of the photosynthesis of primitive blue/ green algae. (Pre)

2.3 bya. (Pre)

The Earth's water and clouds first formed about 4.4 bya. (Pre)

There is evidence that ice ages occurred three more times in the Precambrian Era as 970, 770 and 670 mya. The last one, at 670 mya may have been responsible for a widespread extinction of algal species.

Ozone first began to develop in the Earth's upper atmosphere about 1.6 bya. (Pre)

An ice age occurred around 440 mya (Ordovician period) throughout Africa. Many fish species were destroyed and trilobites suffered. A second ice age occurred near the end of the Paleozoic Era about 360 mya. A third ice age around 290 mya (Carboniferous period) ended a coal-making period in the U.S. and Europe and started one between China and Siberia (see below).

Between ice ages, the Earth had several relatively warm periods. The first of these occurred between 430-60 mya, during the end of the Ordovician through the Devonian periods. A second ice age occurred about 270 mya, during the Permian period. (Pa)

9. How long was the "greenhouse period" in the Mesozoic Era?

Climate Events

10. What happened during this warming trend in the Mesozoic Era?

Climate Events

11. What was the climate like at the beginning of the Cenozoic Era?

Climate Events

12. What climatic changes occurred during the Cenozoic Era?

Climate Events

13. What caused the Earth's global climate to cool?

Climate Events

14. What were the features of Earth's climate from 25-15 mya?

Climate Events

15. How did the Earth's climate change during the Cenozoic Era?

Climate Events

16. Did the ice ages occur in the Cenozoic Era?

Climate Events

Flowering plants evolved about 123 mya. In addition, several climatic changes occurred throughout this era, causing sea levels to rise and fall several times. (M) Flowering plants began to displace conifers, ginkgoes, etc. Insects multiplied, small mammals and birds evolved. (M)

The greenhouse period of the Mesozoic era lasted from about 170-117 mya.

Up until 50 mya, the climate was mild, then it changed. The oceans cooled by several degrees centigrade. The global climate then vacillated up and down, but generally cooled. (Ce)

The Cenozoic era opened with an ice age, resulting in another period of coal-making in western North America.

Between 25-15 mya, the Earth's climate was mild. However, another ice age occurred about 15 mya (Pliocene Epoch). This time, Antarctica went into a permanent deep freeze. (Ce)

The rearrangement of the continents interfered with the ocean currents' distribution of warmth (50-40) mya. (Ce)

Beginning about 3.5 mya, ice ages occurred in cycles of about 90,000 years. Initially, they were not severe but became so about 2.4 mya. (Ce)

The Earth's global climate switched between cold and mild many times during the Miocene Epoch, 25-14 mya. During this time, the Antarctic ice sheets were the largest ever and worldwide volcanic activity occurred. (Ce)

17. How many ice ages occurred during the Cenozoic Era?

Climate Events

18. When did the last ice age occur?

Climate Events

19. What caused the ice ages?

Climate Events

20. When did the earliest known life-forms develop?

Biological Events

21. What are stromatolites and why are they important?

Biological Events

22. When did the nucleus first appear in single-celled organisms?

Biological Events

23. When did chloroplasts first develop?

Biological Events

24. When did multicelled organisms first appear?

Biological Events

The last ice age ended about 18,000 years ago. Between 18,000 and 450,000 years ago, there were at least five major ice ages, not to mention "false" ice ages. Between these ice ages were periods of global warming. (Ce)

Twenty-nine episodes of glaciation occurred between 3.25 mya and 550,000 years ago. The Illinoian Ice Age of 430,000 years ago went as far south as St. Louis, and evidence indicates that icebergs existed within the English Channel at this time. (Ce).

The earliest life forms, in the form of very primitive bacteria, probably appeared between 3 and 3.5 bya. (Pre)

Causes of the ice ages include irregular cycles of the Earth's orbit and gravitational tugs of the sun and the moon during these irregular orbits that alter the Earth's tilt on its axis by a few degrees every 40,000 years.

The first nucleated (nucleus-containing) cells developed about 1.7 bya. These were similar to today's molds or fungi. (Pre)

Stromatolites are pigmented, plant-like bacteria that form large colonial structures in shallow tidal waters. Stromatolite colonies formed very early in Earth's history and fossil remains of stromatolites are among the oldest fossils known (3.5 bya). Living stromatolites exist today virtually unchanged in appearance from that of the earliest fossils. (Pre)

The first multicelled organism was a type of aquatic plant that occurred about 1.3 bya. (Pre)

The first true chloroplasts developed about 1.5 bya. (Pre)

25. When did the first brain-line structures begin appearing in organisms?

Biological Events

26. What were trilobites and when did they first emerge?

Biological Events

27. When did the mollusks first emerge?

Biological Events

28. At what point do we find evidence of the first fish?

Biological Events

29. When did plants first emerge on land?

Biological Events

30. When did animal life first occur on land?

Biological Events

31. When did the earliest trees form?

Biological Events

32. When did the first pine trees (conifers) exist?

Biological Events

They were segmented, shelled organisms with eyes that showed up about 560 mya (Cambrian Period) and survived successfully for millions of years. (Pa)

At the very end of the Precambrian Era and the beginning of the Paleozoic Era, worms and arthropods were developing. These organisms were the first to show brain-line organs (collections of nerve cells) - about 600 mya. (Pre and Pa)

"Bony" fish first emerged about 510 mya (end of the Cambrian Period). The first "jawed" fish emerged about 425 mya (Silurian Period). (Pa)

Mollusks first show up in the fossil record from about 570 mya. (Cambrian Period). (Pa)

About 400 mya (Devonian Period), certain predatory fish developed lungs and ventured onto land. (Pa)

Plants evolving from the earliest blue-green bacteria and algae first appeared on land about 425 mya (Silurian Period). (Pa)

The first coniferous forests occurred about 350 mya (Carboniferous Period). (Pa)

Ancient fern-like trees and forests developed in swampy areas 410-370 mya (Devonian Period). (Pa)

33. At what point do we find evidence of the first true land animals?

Biological Events

34. When did the first major extinction as recorded by the fossil record occur?

Biological Events

35. When did winged insects emerge?

Biological Events

36. At what point do we find evidence of the first reptiles?

Biological Events

37. When did the largest mass extinction in Earth's history occur?

Biological Events

38. How do scientists explain this mass extinction?

Biological Events

39. What happened after this extinction?

Biological Events

40. When were the dinosaurs the dominant vertebrates?

Biological Events

The first major extinction occurred about 370 mya (Frasnian stage of the Devonian Period). Some scientists attribute this and other extinctions to a cosmic object colliding with Earth. This catastrophe was followed by the evolution of amphibians. (Pa)

Millipedes, mites, spiders, scorpions, and insects such as springtails were the first to adapt to carry out their complete life cycle on land. They did so about 398 mya (Devonian Period). (Pa)

The first evidence of animals like reptiles on land appears about 315 mya (end of Carboniferous Period). (Pa)

Dragonflies and other winged insects emerged about 330 mya (Carboniferous Period). (Pa)

Two theories have been proposed:
1) The development of supercontinent Pangea and a subsequent drop in the sea level; and
2) A collision between Earth and a large comet. (Pa)

About 245 mya (end of the Permian Period and the Paleozoic Era), 96% of all marine species became extinct. Reefs and seabeds disappeared.

Almost all of the Mesozoic Era, 235-65 mya. (M)

Other creatures emerged including mammal-like reptiles called lystrosaurs, modern corals and squid-like mollusks and early flowering plants (bennettitales) occurred between 245 and 235 mya (early Triassic Period of the Mesozoic Era).

41. At what point do we find evidence of the first bird-like reptile?

Biological Events

42. At what point do we find evidence of monotremes (duckbill platypus)?

Biological Events

43. At what point do we find evidence of the marsupials (kangaroos, opossums)?

Biological Events

44. At what point do we find evidence of the first placental mammals?

Biological Events

45. What happened about 65 mya?

Biological Events

46. What happened during this extinction?

Biological Events

47. What animals first appeared in the Cenozoic Era?

Biological Events

48. At what point do we find evidence of the New and Old World monkeys?

Biological Events

The monotremes emerged before 175 mya (Jurassic Period) in Australia. (M)

The first bird-like reptile, Archaeopteryx, shows up in the fossil record about 123 mya (Cretaceous Period). (M)

About 114 mya (Cretaceous period) in Mongolia, according to the fossil record. (M)

The marsupials emerged about 125 mya (Cretaceous Period). (M)

Plants in western North America suffered, sea level dropped, and reefs and many species of marine plants and animals died out. Small reptiles, birds, and small mammals survived. (Ce)

The fossil record indicates that a mass extinction occurred about 65 mya, possibly as a result of a cosmic object striking Earth. (Ce)

New and Old World monkeys emerged about 35 mya, along with rhinos, pigs, and bears. (Ce)

The ancestors of lions and bears emerged about 62 mya. (Paleocene Epoch). Rodents, bats, whales, horses, elephants and ancient cats and dogs evolved between 55-35 mya (Eocene and Oligocene Epochs). (Ce)

49. At what point do we find the first evidence of grasses?

Biological Events

50. At what point do we find the first evidence of human ancestors?

Biological Events

51. When did deer and antelope first emerge?

Biological Events

52. When did orangutans and baboons first emerge?

Biological Events

53. At what point do we see the first evidence of early humans?

Biological Events

54. When did humans first use tools and fire?

Biological Events

55. Where did humans originate?

Biological Events

56. At what point do we find the first evidence of the modern horse?

Biological Events

Common ancestors of both humans and the great apes emerged, according to fossil record about 20 mya. (Ce)

Grasses evolved from bamboo-like plants about 24 mya. They are considered world-transforming plants as this heralded a global change to a cooler, drier time that allowed for grazing animals to evolve. (Ce)

Orangutans and baboons emerged about 10-4 mya. (Ce)

Deer and antelope and ancestors of cows emerged between 19-20 mya. (Miocene Epoch). (Ce)

Stone tools date back to about 2.4-2 mya, but the use of fire isn't obvious in the paleontological record until about 1 mya. (Ce)

Early Australopithecines emerged about 4 mya, followed by Homo habilis 2 mya, and Homo erectus 1.8 mya (Quaternary Period, Recent Epoch). (Ce)

The modern horse emerged about 3.7 mya, along with primitive cattle. The zebra emerged later (2.5 mya). Lions and leopards emerged about 1.8 mya. (Ce)

Humans originated in Africa about 3.7 mya. (Ce).

57. When did Homo sapiens first emerge?

Biological Events

58. When did woolly mammoths exist?

Biological Events

59. When did the Neander-thals exist?

Biological Events

60. When did speech and language begin?

Biological Events

61. When did art and medicine first appear?

Biological Events

62. When did modern humans first emerge?

Biological Events

63. When were calendars developed?

Biological Events

64. When were livestock domesticated?

Biological Events

Woolly mammoths existed about 120,000 years ago. (Ce)

Homo sapiens emerged between 600,000 and 200,000 years ago. (Ce)

Current thinking has complex, modern speech and language beginning about 43,000 years ago and probably Neanderthal people had somewhat more limited speech capacity than modern humans. (Ce)

The Neanderthals (Homo sapiens Neanderthals) evolved about 120,000 years ago and existed for 80,000 years in Eurasia (longer than the Homo sapiens, of which we are members, have so far existed). Neanderthals were extinct by about 34,000 years ago. (Ce)

Modern humans emerged about 40,000 years ago. (Ce)

Both art and medicine show up in the Neanderthal culture around 60,000 years ago, and before. (Ce)

Between 12,000-6,500 years ago dogs, sheep, goats, cows, and horses were domesticated. (Ce)

Calendars were developed as early as 35,000 years ago. (Ce)

65. When were crops domesticated?

Biological Events

66. When did human civilizations begin?

Biological Events

67. When was the printing press developed?

Biological Events

68. What was the first important form of energy use?

Biological Events

69. When were the Earth's main population surges?

Biological Events

70. When were the earliest continents formed?

Geologic Events

71. What are the ages of the oldest rocks on Earth?

Geologic Events

72. When did the Earth's moon form?

Geologic Events

Human civilization began about 10,000 years ago. (Ce)

Between 10,600-8,000 years ago, wheat, rice, and other crops were domesticated. (Ce)

Steam energy about 1717 A.D., followed by the development of fossil fuels in 1825, and nuclear energy in 1942.

The printing press was developed in 1450 A.D.

The earliest continents were first formed about 2.8 bya. (Pre)

The Earth's population booms were in 1000 A.D., 1700, 1930, and the 1960s.

The Earth's moon formed about 4.5 bya. (Pre)

The oldest rocks date back to 3.8 bya. (Pre)

73. Where did the first coal deposits form and how long did it take?

Geologic Events

74. Were other coal deposits formed? If so when?

Geologic Events

75. When did the supercontinent Pangea fully form?

Geologic Events

76. When did the oil deposits form?

Geologic Events

77. When did Pangea begin to break apart?

Geologic Events

78. Were any other oil deposits laid down?

Geologic Events

79. When did Earth's magnetic fields reverse polarity (North Pole became South Pole and vice-versa)?

Geologic Events

80. Have the magnetic reversals stopped?

Geologic Events

Around 270 mya (Permian Period), other coal deposits were laid down between China and Siberia due to tectonic forces. (Ce)

The first coal deposits formed in what is now Poland, Germany, England, Pennsylvania, and Kentucky when Europe and the eastern United States collided. The collision buried ancient fern forests between 320-290 mya (Devonian and Carboniferous Periods). (Pa)

The first group of oil deposits formed about 170 mya (Jurassic Period). (M)

Pangea fully formed about 230 mya. (M)

About 93-85 mya, oil accumulated at the greatest rate ever from organic sediments laid down in the Gulf of Mexico, Venezuela, North Africa, Saudi Arabia, and Iran. (M)

Pangea broke apart between 130-140 mya. (M)

The magnetic reversals continue and the rate of reversals has actually increased to about 40 reversals in the most recent 10 million years (Tertiary and Quaternary Periods). (Ce)

Before 65 mya, the Earth's poles had switched only once (between 84-72 mya, end of the Cretaceous Period). In the 10 million years following the presumed cosmic impact at 67 mya, the magnetic reversals occurred 16 times.

81. What geological events occurred in the Cenozoic Era?

Geologic Events

82. Do scientists think there were any other major cosmic collisions during the Cenozoic Era?

Geologic Events

83. When did Australia, South America, and Antarctica split apart?

Geologic Events

84. Where there other episodes of volcanic activity later in the Cenozoic Era?

Geologic Events

85. When did the magnetic poles reach their current locations?

Geologic Events

Geologic evidence exists to indicate that another cosmic impact occurred about 37 mya. (Ce)

The North Atlantic Ocean opened up, Australia and Antarctica split and India slid into Eurasia between 60-45 mya. (Ce)

The last widespread and intense episodes of volcanism occurred about 1 mya. (Ce)

These three continents split up between 35-30 mya (Oligocene Epoch). (Ce)

About 730,000. (Ce)

The Great Debate

Target Grades: 6 - 8

SUMMARY: Students explore options for Loess Hills land use and debate their positions.

OBJECTIVES: The student will learn of various options for Loess Hills land use through research and debate.

GROUP SIZE: Any number

DURATION: Three to five class periods of 45 minutes each

KEY WORDS: Loess Hills, development, sustainable agriculture

STANDARDS: *National Geography Standards*
Understands how human actions modify the physical environment.
Understands that culture and experience influence people's perceptions of places and regions.

Standards for the English Language Arts
Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources to communicate their discoveries in ways that suit their purpose and audience.

MATERIALS: News articles concerning the Loess Hills, and information obtained through internet searches.

BACKGROUND INFORMATION:

The Loess Hills were created approximately 25,000 years ago as the glaciers were melting. They left behind silt, and when the water level dropped, the wind blew the silt to the east side of the Missouri River valley where it formed the Loess Hills. They are the second largest deposit of loess soil in the world. Only Northern China has a greater deposit of loess soil in one location.

Effects of human habitation on the Loess Hills include: prairie areas have decreased; woodland areas have increased; natural prairie fires have been eliminated; prairies have been plowed under for farmland; and concern for preservation has created areas of the Loess Hills that have been set aside for parks where education and recreation can coexist.

PROCEDURE:

1. Make multiple copies of news articles related to the Loess Hills dilemmas. (Articles on topics including: how the hills were formed; their unique plant life; their endangered species; and the many controversial uses of the land.)

2. Have groups of students read the articles and then take class time for each group to share what they have learned from their articles.

3. After discussing the information, tell your students that you will be having a debate over the issue of land use in the Loess Hills. Next, you'll need to assign roles for the debate. Two or three people could be assigned to each of the positions. (The second person could be their spouse, the third their lawyer.) They will need to research to find facts to augment their positions.

   Assignments:

* Loess Hill Billy	*Naturalist Nancy	*Metro Utilities
*Jealous Jane	*Farmer Jones	*Business Bob
*Department of Natural Resources	*Farmer Smith	*Landfill Phyl

4. Loess Hills Billy will be the one to decide the outcome of the debates. Be certain to pick a student for this role who will take the role seriously.

5. Debate concerns and positions in two separate sessions. One with family members, the second with community members.

6. Begin by reading the inheritance story of Loess Hills Billy to the class. Give them time to prepare their arguments, then debate. This activity could last a number of days depending on the the amount of background information you have for your students, how much they prepare, and how long the two debates take.

Loess Hills Billy

Your great uncle just passed away. At his will hearing you have learned that he gave you 1000 acres of land in the Loess Hills area of Iowa. This acquisition of land has put you in the center of a local debate. You find yourself remembering the past and trying to make wise decisions for the future.

When you were young you spent much of your free time with your great uncle. Together the two of you would hike through the hills spotting birds and identifying plants. You recall this is where you developed your love of all living things. You learned how to identify many prairie plants including the yucca, which your uncle said was rare in Iowa. You remember drawing different species in a notebook and coloring and labeling them.

Loess Hills Billy

Your family also spent vacations camping on your uncle's property. He was always so careful about where you could camp. He didn't want people hiking the same trails over and over as he feared the trail would cut too deep a groove into his precious hills. You remember hearing different calls of owls at night, and seeing the tiny short-eared owl first thing in the morning in the prairie grasses.

Your uncle used to tell stories long into the night at the campfire ring he'd built to keep fire away from the flammable grasses of the prairie. He'd tell stories of Lewis and Clark, the Native American tribes that had used the hills, and how he worried that the hills would disappear if his neighbors kept selling their property for urban development.

Even though you were too young to completely understand, your uncle found a kindred spirit in you, and you listened longer than most. Now he is gone. And you are the sole caretaker of his precious hills. Even though you've been away for awhile, he has left them in your care. You realize that you will need to make a few decisions concerning the future of the hills. You have scheduled some meetings to help you decide the future of your land.

The first meeting is with your family, all of whom have their own hidden agendas.

Family Members
(sister) Jealous Jane
(brother) Business Bob
(cousin) Landfill Phyl
(cousin) Naturalist Nancy

Community Members
Neighbor Farmer Jones
Neighbor Farmer Smith
Metropolitan Utilities
Department of Natural Resources

(Sister) Jealous Jane

Your oldest sister Jane is married to a successful businessman in town. She has everything anyone could want: a house, two cars, a boat, a little cabin at the lake, and status in the community. Jane never had time to hike with your uncle throughout the hills, nor did she care about the things you love; birds, animals and the plants.

Now that you own the property in the Loess Hills, Jane is extremely excited about building a new and bigger house in the bluffs area. All her society friends are moving "up" into the hills. She insists you allow her to buy a few acres so she can build the house of her dreams. (She has bragged to friends how she can get them prime property in the area also.) She can afford to pay you BIG BUCKS for the property.

(Brother) Business Bob

Your older brother Bob has a real estate business. He is doing pretty well in his career but he always wanted to run with the "big dogs". Since you inherited the 1000 acres of prime Loess Hills, he has been crunching numbers and seeing dollar signs. He has a plan that will make him and you very wealthy. Both of you could retire on the sale of the property when divided into sub units for development. (it would also make sister Jane very happy!)

(Cousin) Landfill Phyl

Cousin Phyl is a businessman. He owns a landfill company. He is in charge of all of the hauling of solid waste for the nearby community. He is under a lot of stress as his current landfill is about full. He has been spending lots of time trying to secure more land for a new landfill. He had approached your uncle many times about the hills as they are a perfect place for a landfill, but was turned down each time. Now that you own the hills the pressure is on. His business may fold without your help.

(Cousin) Naturalist Nancy

Nancy has her naturalist degree but has been unable to find a position in which to use her knowledge. She has been doing landscaping for the city parks and for private owners to pay her bills. Nancy could spend hours and hours outdoors watching birds and documenting their habits of feeding and nesting. (She is the only other family member besides you that seems to have inherited your uncle's love of the land.) Nancy's dream is to establish a prairie preserve and do major research on native plants and bird habits. Nancy would like to turn your acres of Loess Hills into her dream.

(Neighbor) Farmer Jones

Farmer Jones has land on the north and east sides of your property. He would like to buy most of your hills to join his two properties. He has plans to contour the hills and plant row crops of beans and corn. He has the money and can pay you up front. He takes good care of his land by conservation tilling, rotating, liming and fertilizing.

(Neighbor) Farmer Smith

Farmer Smith does not want to buy the land. He just wants to rent some of it. He would like to rent half of it to pasture his cattle, and use another quarter to allow his cattle to move across the corner of the property. They would be driven by riders on horseback, about 200 head, twice a year. Smith would pay rent for the use of the land twice a year.

Metropolitan Utilities

The Metropolitan Utilities located 25 miles away has always had an interest in the property. They need to run power lines nearby and could save money by running the lines through your property. They would like to clear a large easement and put up large high-power lines. They are willing to pay top dollar for the land and begin right away.

Department of Natural Resources

The Department of Natural Resources understands the uniqueness of the property you now hold. It would like you to donate the land to the state to be used as a preserve. Naturalists working for the department are eager to study the rare and endangered animal and plant species that exist on your property.

EVALUATION OPTIONS:

1. Evaluate students' levels of participation during the large and small group discussions and research.

2. Give students some basic information about a real or a made-up controversy. Have them write two newspaper articles, one factual and one slanted or opinionated. Discuss the differences.

3. Have students write four issues that concern them about the Loess Hills. Then pick one of the issues, and state the facts and opinions of the issue.

EXTENSIONS:

1. Have students list possible groups or people to whom they could write concerning land use in the Loess Hills.

2. Invite a leading environmentalist, a naturalist, and/or a newspaper editor to your class to discuss the dilemma of land use in the Loess Hills.

RESOURCES:

http://www.mapletonpress.com> Lyon Publishing, home of three newspapers in the Loess Hills area.

Articles in the *Des Moines Register* include:
"Iowa's Loess Hills, Awakening to the Possibilities", Nov. 23, 1997
"Where Misplaced Yucca and Rare Fern Grows", Nov. 23, 1997
"The Hills Can't Wait', Nov. 23, 1997
"The Fragile Giants: A Loess Hills National Park", Nov. 23, 1997
"Appreciation For Loess Hills", Nov. 29, 1997
"Hills So Fragile We Could Kill Them With Love", Nov. 30, 1997
"No Way To Treat A Treasure", Nov. 30, 1997
"Rescuing Iowa's Miniature Mountains", Dec. 7, 1997
"Our Land, Our Legacy", Dec. 7, 1997
"Brian Duffy's Loess Hills Magic", March 22, 1998
"Help Save Our Hills", March 22, 1998
"Curbing the Appetites of Hungry Canons", April 7, 1998

See resource section of this curriculum for additional sources.

Make a Trip - Take a Trip to the Loess Hills

Target Grades: 9 - 12

SUMMARY: Students create a bus tour for exploring the Loess Hills region and complete the activity by taking the trip.

OBJECTIVES: Students will appreciate the unique diversity of historic, cultural, and natural resources found throughout the Loess Hills region.
Students will learn to write for travel information, make decisions concerning destinations and plan a route for a bus trip throughout the Loess Hills region.

GROUP SIZE: Any number.

DURATION: 3-5 sessions, 45 minutes each and one school day for trip

KEY WORDS: Loess Hills, tourism

STANDARDS:

Science Standards
Historical perspectives
Understandings about science and technology

National Geography Standards
Understands the physical and human characteristics of place.
Understands how physical systems affect human systems.

Standards for the English Language Arts
Demonstrate competence in the general skills and strategies of the writing process.
Demonstrate competence in the stylistic and rhetorical aspects of writing.
Effectively gather and use information for research purposes.
Demonstrate competence in the general skills and strategies for reading information.

MATERIALS: State of Iowa road maps, county road maps for all Loess Hills counties, brochures on attractions, parks, museums and other points of interest in the Loess Hills area, letter writing materials including envelopes and stamps for inquiries, and internet access if available.

BACKGROUND INFORMATION: The Loess Hills have become increasingly recognized as a unique area on a local, state and national level. It has been estimated that this one of a kind region in Iowa attracts over one million visitors to Iowa and its Loess Hills communities each year. These visitors add thousands of dollars to the economy of these communities and increase our awareness of the value of "eco-tourism". In many ways, the more the Loess Hills are utilized through recreation activities and tour groups, the more we can preserve the hills as a resource.

Several agencies have been created because of the demand for tourism opportunities in the Loess Hills area. They include the Loess Hills Hospitality Association, and the Western Iowa Tourism Region. (See resource section for these and other sources to help your students find information for their planning.)

The creation of the "Loess Hills Scenic Byway", designated by the state of Iowa in 1996, has produced a road map of all seven Loess Hills counties. The map illustrates over 200 miles of scenic roadways and points of interest. This is the first designated scenic byway for Iowa, and the National Geographic Society has selected the Loess Hills Scenic Byway as "one of the best scenic byways in the country".

PROCEDURE:

1. Read the background information to students and explain that they will be creating a group trip through the Loess Hills area.

   Junior High variation could be to have the route predetermined by teacher and have the students research and report on the points of interest along the route.

High School should include dividing classes into groups in which each group will create a detailed map showing the route of travel, stops at Loess Hills attractions, distances between stops, amount of time between stops and at attractions, considerations for eating and restrooms, budget plan for total cost and cost per student.

2. Next, students should research information on attractions and other points of interest by writing letters directly to area attractions and sites or by using the internet if it is available to you and your students. Ask students to group their information into the following categories: recreational, cultural, historical, and ecological.

3. Now students will need to determine a time schedule including the departure and return times so that the number of stops and the time spent at each one can become part of their plans. (Because of school time constraints, you may have to predetermine the length of the trip. For example: If you leave school at 9:00 am and arrive back at school at 3:00 pm, your trip could not be longer than six hours. Find out if there are restrictions at your school.)

4. After choosing some destinations, students can use maps or the internet site >www.indo.com/distance> to calculate the distance from your school to the first site, subsequent sites, and then back to your school. Have students add the miles together to determine the total miles and divide by 55 (assumed average mph for your bus) to determine the total driving time.

5. Students will need to determine the time needed for lunch, restroom breaks, and how much time they will spend at each of the stops. Length of time per stop will vary depending on the activity. For example, a nature hike will require more time than a stop at a museum. (Students should use “Loess Hills Tour Work Sheet”, and the “Background Information - Visitor Support Services” sheet for this part of the lesson.)

6. Next, students will need to determine their packing list for the trip. Have students brainstorm items that will be needed for the trip. (items to be considered: prescription medicines; allergy or asthma medicines; a first aid kit; emergency phone numbers; hats; sunscreen; bug spray; sunglasses; lunches; snacks; CD players and headphones; cameras; money for gift shops; and ziplock baggies to collect loess kindchens or soil, etc.)

7. Finalize the trip itinerary and make copies for each student and his/her family. Send permission slips home for parental permission for the trip.

8. Take the trip!

EVALUATION: Students will be evaluated by observing their cooperative group work, their success in researching writing for and obtaining information; and their successful planning of the detailed itinerary.

EXTENSIONS:

1. Students may present information on the bus as they head from site to site or at the site itself.
2. Students may develop questions to ask as they visit each site.

RESOURCES: Have students write to the following addresses to obtain Loess Hills Scenic Byway maps:

Loess Hills Hospitality Association
109 Oak Street
Moorhead, IA 51558

Harrison County Village
Loess Hills Welcome Center
2931 Monroe Street
Missouri Valley, IA 51555

These maps give some background information as well as suggestions for places to visit. After looking at maps and selecting possible destinations, students may want to write to nature centers, visitor centers, and Chambers of Commerce for more information.

Major Iowa Tourism Region:
Most of these agencies have a naturalist on staff. Call for further information:

Iowa Division of Tourism:
Fremont County Conservation Board @ (712) 374-2347
Harrison County Conservation Board @ (712) 647-2785
Mills County Conservation Board @ (712) 527-9685
Monona County Conservation Board @ (712) 423-2400
Plymouth County Conservation Board @ (712) 947-4270
Pottawattamie County Conservation Board @ (712) 328-5638
Woodbury County Conservation Board @ (712) 258-0838

Internet Sites:

<indo.com/distance> Finds the distance between cities.
<tgsv7.nws.noaa.gov/weather/current/KCBF.html> Current weather conditions for Council Bluffs, IA.

<http:www. state. ia. us/government/dn r/organiza/ppd/waubonsi/ htm> This site tells about the Loess Hills State Park, has a map of the park, and will link you to other state parks in Iowa.

Map 1. The Loess Hills region. Heidi Perry.

This map used with permission from Land of the Fragile Giants.

Loess Hills Tour Work Sheet

	Attraction Site	Arrival Time	Departure Time	Distance between Stops (Miles)	Eating/ Restrooms	Guest Speaker	Cost ($) per Stop
1st Stop							
2nd Stop							
3rd Stop							
4th Stop							
5th Stop							
6th Stop							
7th Stop							
8th Stop							

Visitor Support Services

County	City	Fuel Gas	Fuel Diesel	Auto Service	Public Rooms	Lodging	Food	Pay Phones	Hospital Medical
Fremont	Hamburg	x	x	x	x	x	x	x	x
	Randolph			x	x			x	
	Riverton	x	x		x		x		
	Sidney	x		x	x		x	x	
	Tabor	x		x	x		x	x	x
	Thurman	x				x			
Harrison	Little Sioux	x		x	x		x	x	
	Logan	x	x	x	x		x	x	
	Magnolia			x	x		x		
	Missouri Valley	x	x	x	x	x	x	x	x
	Modale	x	x				x	x	
	Mondamin	x	x				x	x	
	Pisgah	x	x	x	x		x	x	
Mills	Glenwood	x	x	x	x	x	x	x	
	Malvern	x	x	x	x		x	x	
	Pacific Junction	x	x		x	x	x		
	Silver City	x	x	x	x		x	x	
Monona	Blancoe	x		x			x	x	
	Castana							x	
	Mapleton	x	x	x	x	x	x	x	x
	Moorhead	x	x	x	x	x	x		x
	Onawa	x	x	x	x	x	x	x	x
	Rodney							x	
	Soldier	x		x			x	x	
	Turin					x			
Plymouth	Akron	x	x	x	x	x	x	x	
	Hinton	x	x		x		x	x	x
	LeMars	x	x	x	x	x	x	x	
	Merrill	x	x	x	x		x	x	
	Westfield	x	x	x	x		x	x	

Visitor Support Services

County	City	Fuel Gas	Fuel Diesel	Auto Service	Public Rooms	Lodging	Food	Pay Phones	Hospital Medical
Pottawattamie									
	Council Bluffs	x	x	x	x	x	x	x	x
	Crescent	x	x	x	x		x	x	
	McClelland				x		x	x	
	Mineola								
	Underwood	x	x	x		x	x	x	
Woodbury									
	Bronson						x	x	
	Lawton	x					x	x	
	Movilla	x	x	x	x	x	x	x	x
	Oto	x		x	x		x	x	
	Sergeant Bluff	x	x	x		x	x	x	
	Sioux City	x	x	x	x	x	x	x	x
	Sloan	x	x	x	x	x	x	x	
	Smithland	x	x				x	x	

Soil Erosion

Target Grades: 9 - 12

SUMMARY: Students will design and carry out an experiment to learn about erosion.

OBJECTIVES: The students will observe how grass, crop residue, contouring, and strip farming help to prevent erosion. The students will be able to explain how slope affects the rate of water erosion.

GROUP SIZE: Any size

DURATION: Two 45 minute class sessions

KEY WORDS: crop residue, erosion, and strip farming.

STANDARDS:

Science Standards
Abilities necessary to do scientific inquiry
Understandings about scientific inquiry
Change, constancy and measurement

National Mathematics Curriculum Standards
Students will explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations.
Students will extend their understanding of the process of measurement.

MATERIALS: Large aluminum roasting pans- 4 for each trial, soil, sod, and crop residue (corn stalks, grass clippings, etc.), support boards (plywood board with a 1 -inch strip of wood nailed to one end to stop the pan from slipping off the plywood), small sprinkler can, plastic bags or plastic sheet, four collection containers (gallon tin cans), and 4 screens to aid in the collection of soil to determine runoff.

BACKGROUND INFORMATION:

The formation of the Loess Hills took place primarily during the last two glacial advances, the Illinoian (approximately 130,000 to 150,000 years ago) and the Wisconsin (approximately 18,000 years ago). The advancing glaciers stopped north of the Hills region and were responsible for the formation of the Hills by the following mechanisms: massive glaciers ground rock into powder or glacial flour as glacial water melted during the warming seasons, and carried the rock flour downstream; the water covered wide flood plains during the warmer summers but receded when colder temperatures stopped the glaciers' recession; the finely ground rock left on the flood plain was picked up by strong winter winds and was dropped on some leeward upland surface- this deposition of windblown silt in significant depths of 60 to 200 feet became the land formation we know today as the Loess Hills of western Iowa.

CHARACTERISTICS OF LOESS:

Loess - small-grained particles of quartz silt between .002 and .05 mm in diameter, larger than clay (less than .002 mm in diameter) and smaller than sand (between .05 and 2.0 mm in diameter).

Homogeneous- lacking gravel, rock and horizontal stratifications typical of most rock and soil layers, color is often a uniform yellow-ish brown.

Permeable - precipitation runs rapidly through the loess causing rivers in the area to fill rapidly during rainfall and cause flooding. On steep slopes, rain runs off rather than into the soil. Well drained loess provides a state of aridity for the variety of drought resistant plants and animals that inhabit the area.

When loess is disturbed or becomes wet its cohesive quality is greatly diminished. Loess is unable to support its own weight when saturated and large blocks of soil collapse in wet periods. Human land uses that have increased moisture and have required that the loess support additional structures or fill have been additional sources of collapse. The loss of the protective cover of native vegeta-

tion has increased erosion of the area. This additional erosion raises the sediment load in stream beds and threatens normal water flow, water quality, and aquatic wildlife.

VOCABULARY:

Crop residue - the material that is left on the ground following the harvesting of a crop such as corn or beans.

Erosion - the wearing away of the land by water, wind, ice, or chemical reactions.

Strip farming - the method of farming that includes the practice of alternating crop and grass-like vegetation in the attempt to reduce soil erosion.

PROCEDURE:

1. Discuss vocabulary words and concepts. Have students record the the definitions in their notebooks.

2. Fill the four roasting pans with soil. Prepare the pans as follows:

    a. Leave the soil barren
    b. Cover soil with grass
    c. Place 3-inch strips of grass alternating with 3-inch strips of bare soil
    d. Cover with crop residue

3. Create a "spout" on each of the pans by bending the pan in the center of one of the ends of each pan.

4. With the pan level, sprinkle water on the soil until it is saturated.

5. Place blocks under the support boards to create a slope of 4% (a 1 inch block will yield a 4% slope)

6. Place the pan on the support board.

7. Lay the plastic sheet or the bags below the trays. Place a collecting can below each of the spouts. Top each with a screen.

8. Slowly pour a quart of water through the sprinkler can over the first sample. Repeat this procedure for each of the other three pans.

9. Record the amount of water collected from each sample. Note the amount of soil runoff for each sample. If possible use a balance to measure the amount for each sample.

10. Repeat the procedure using various slopes. Other possible slopes:

    a. 8% slope - use a 2 inch block
    b. 12% slope - use a 3 inch block
    c. 16% slope - use a 4 inch block

DISCUSSION QUESTIONS:

1 . Which sample absorbed the most "rain"? The least?

2. Why was there a difference in the ability to absorb the water in each of the samples?

3. How does strip farming prevent erosion?

4. How does crop residue prevent erosion?

5. What other methods can be used to stop erosion?

6. How could these methods be used in rural areas? In urban areas?

7. Where does the eroded soil end up?

8. What effects can erosion have on other natural resources such as wildlife, fish, water quality, etc.?

EVALUATION: Each student will be responsible to write a summary of the procedures and the results of the trials conducted in this experiment.

EXTENSIONS:

1. Students may wish to visit a rural area and record the types of erosion prevention or control practices being implemented.

2. Students may develop a brochure for local farmers or farm organizations telling about the class experiment and encouraging farmers to explore erosion control methods.

3. Invite a soils expert from the Natural Resource Conservation Service (NRCS - formerly the Soil Conservation Service - SCS) to visit your students and discuss soils and their properties.

Picture This:
Erosion in the Loess Hills

Target Grades: 9 - 12

SUMMARY: Students photograph Loess Hills erosion sites, identify erosion type, gather information on erosion photographed and report or display findings.

OBJECTIVES: Students will be able to explain why loess soil is so erosive compared to other Iowa soils.

GROUP SIZE: Any number

DURATION: 2 - 3 sessions, 45 minutes each

KEY WORDS: cat steps, gully formation, dendritic, and lateral erosion.

STANDARDS:

Science Standards
Structure of the earth system
Change, constancy and measurement
Understanding about scientific inquiry

National Geography Standards
Understands how human actions modify the physical environment.

MATERIALS: News articles concerning erosion in the Loess Hills area, cameras, film and film development. (Optional variation materials include mounting material, colored pencils, and sketch pads or paper.)

BACKGROUND INFORMATION: Erosion is a geologic process that has been sculpting the Loess Hills for thousands of years. Some types of erosion are unique to the Loess Hills (cat steps), while other types are found in other environments (gully formation). Erosion can be a natural process or can be caused by human actions. Erosion can occur suddenly or over a long period of time.

EROSION TYPES:

Gullies - trenches worn in the earth by running water. In the Loess Hills they can be many miles long, more than 100 feet wide, and as deep as 80 feet.

Dendritic erosion - a branching tree-like formation of soil formed by drainage systems.

Lateral erosion - one-sided erosion which creates steep giant bluffs also known at truncated spurs. In the Loess Hills, lateral erosion is caused by the Missouri River.

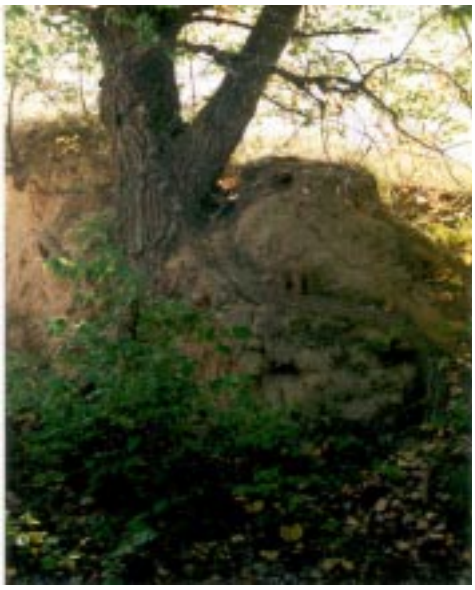
Cat Steps - The repeated slipping and downslope movement of shelves of loess soil creates cat steps. They are seen as a natural result of loess' inherent tendency toward failure on steep slopes and of loess' tendency to shear off in vertical planes, resulting in numerous small soil slumps rather than one massive collapse.

PROCEDURE:

1 . Review past and present news articles related to Loess Hills erosion. Also review erosion types using books and periodicals.

2. Students are assigned to take 3 - 4 pictures of the erosion types found in the Loess Hills (gullies, dendritic, lateral, and cat steps). The number of students in each class and the availability of cameras, film, and budgeted funds for development will affect the number of pictures each student can take and that will be required to fulfill this activity. (Costs can be reduced by utilizing an active camera club or year book club in your school. Assistance in film development may be obtained through a local camera company or perhaps a department store such as Walmart.)

3. Decide if you want the pictures taken as homework or as a school project. It you decide to do it as a group, you'll need permission from your principal and the parents to take the class out into the community to photograph erosion.



4. Have each student complete a narrative for every picture that he/she takes of a site. This should include: location of site; type of location (e.g. residential, industrial, agricultural, etc.); type of erosion; cause of the erosion (human or natural); and note whether or not there has been any effort to control the erosion.

5. After pictures are developed, they are matched with their narratives.

EVALUATION: Students are evaluated by examining their pictures or drawings (alternative to photographs) and determining if they are of erosion sites, and if the written narratives contain the necessary information about the site and its erosion.

VARIATIONS:

1. Students can be placed into groups and assigned "natural" or "human caused" erosion types to photograph. Group comparisons can be discussed and used in the evaluation along with the pictures and the narratives.

2. Pencil sketches can be done of "natural" and "human caused" erosion bringing art into the activity.

3. Use digital cameras and computers to add technology to the project.

EXTENSIONS:

1. Map out pictured erosion locations on a county or city map.

2. Discuss whether erosion occurs in all areas of the map or only in some areas. Brainstorm reasons why patterns might exist. Have students research the causes of the noted erosion.

RESOURCES:

Drewes, Jacqueline. (1994). "Reflections on Gullies" from Fragile Giants: Landscapes. Environments & People of the Loess Hills. Ames, IA: Iowa State University.

Iowa Department of Natural Resources. (1984). Iowa Conservationist: A Special Loess Hills Issue (April 1984, Volume 43, Number 4). Iowa City, IA: University of Iowa Press.

Mutel, Cornelia F. & Mary Swander (1994). Land of the Fragile Giants, Iowa City, IA: University of Iowa Press.

Bug Biodiversity

Target Grades: 9 - 12

SUMMARY: Students will determine, compare and contrast the species diversity of a natural area and a human-managed area.

OBJECTIVES: Students will be able to observe and record random field samples of insects and calculate the species diversity of the area.

Students will be able to compare and contrast the characteristics of a natural area and of a monoculture.

GROUP SIZE: Any number

DURATION: 2 class sessions of 45 minutes each and one school day for a field trip to observe insects in natural and human-managed areas.

KEY WORDS: biodiversity, diversity index, and monoculture.

STANDARDS: *Science Standards*
Abilities necessary to do scientific inquiry
Behavior of organisms

National Mathematics Curriculum Standards
Mathematics as communication
Mathematics as problem solving

MATERIALS: Insect sweep nets, prairie insect field guides, prairie critter record cards, observation grids, hand lenses, pencils, journals, and calculators.

BACKGROUND INFORMATION: One of the concepts developed in this activity is that of "species diversity". Through comparisons of a native grassland such as a Loess Hills prairie or other area of native vegetation and a mowed yard or human-managed area, students will discover that native areas are more diverse. Human managed areas with one dominant species of plant are referred to as a monoculture. Areas with a high biodiversity (many different kinds of living organisms) will have many more ecological niches with little competition among species for resources.

This contributes to the stability of the ecosystem. Monocultures require constant care and consume great energy reserves and time to cultivate the species that are present. With few species present monocultures are very prone to collapse in their food webs. Diseases often devastate monocultures because there are so few species and so few niches.

PROCEDURE:

1. Review with your students the concepts of: biodiversity, diversity index, and monoculture. Explain that you will be examining two areas: one a natural area; and the other a human-managed area to observe insect populations and determine the species diversity of the area.

2. Determine your field trip sites and obtain permission to visit the sites as well as permission from your principal and the parents for the students to participate.

3. Divide your class into working groups of 2-4 students. Have one member from each group gather the materials that will be needed on the trip: a sweep net; a clipboard or folder to hold the critter cards and grid sheets for field observation; pencils; and student journals.

4. Travel to the first of the two sites. Once there randomly assign areas to examine to the groups.

5. Students will then attempt to count the number of insect species within the boundary of their assigned area using the grid sheet. It is not necessary to give each insect column a name, like "grasshopper" or so on. If the students do not know the name of the insect, just have them call it "insect A or insect B".

6. After recording the diversity of the area, have the students examine two to four insects using the critter cards, the hand lenses for careful observation, and the field guides to research additional information on the insects.

   Note: Remind students that they are only observing the insects, not collecting. Care should be taken to cause no harm to the organisms.

7. Travel to the other site and repeat the above procedures. Afterwards, return to your school and have students examine their data.

8. The next day during class have each group determine the species diversity of the two areas they observed. Species diversity can be measured by using Simpson's Index. It consists of this calculation:

$$SD = \frac{N(N-1)}{n(n-1)}$$

N=total of all organisms in the sample
n=total members of one species present in the sample
SD= species diversity index

The following is an example of how the calculation can work:

A sample of insects and spiders were observed in a 10 meter square area on a prairie. The sample contained 75 total organisms made up of the following groups: 20 grasshoppers; 5 assassin bugs; 2 ambush bugs; 3 wasps; 10 ladybird beetles; 25 leaf hoppers; 5 garden spiders and 5 harvestmen.

$$SD = \frac{75(75-1)}{20(20-1) + 5(5-1) + 2(2-1) + 3(3-1) + 10(10-1) + 25(25-1) + 5(5-1) + 5(5-1)}$$

$$SD = 5550/1138 = 4.87$$

The species diversity of this area is 4.87. That number can be compared to zero and another value from a separate habitat to determine which area has the greatest diversity of organisms.

EVALUATION: Have students write the reasons why they think the natural area has a higher S.D. than the human-managed area. Ask them to brainstorm ideas for ways that the S.D. could be increased in the human managed areas. Another option would be to create a scenario whereby the natural area is about to be clear cut or be plowed under. Ask your students to write a paper with support from research that presents a case for preserving this natural area.

EXTENSIONS:

1. Back in the classroom have students make graphs of the insect species found in their areas, allowing for a visual comparison of types and numbers of the insects observed.

2. Have each group share their data and compare the data for differences and similarities.

3. Consider inviting a wildlife biologist, a naturalist, or soil conservationist to your classroom to discuss the need for maintaining diversity in areas of habitat.

RESOURCES:

Lawrence Hall of Science. (1987). Animals in Diversity. Set 11. OBIS, Outdoor Biological Instructional Strategies. Nashua, N.H.: Delta Education.

Nichols and Entine. (1978). Prairie Primer, Madison, WI: Wisconsin Extension Publishing Company.

PRAIRIE CRITTER RECORD CARD

Team _____ Activity Site _____
Date _____

Reconstruct your organism here:

HEAD THORAX ABDOMEN

Size: (Draw a line as long as the organism.)

· Are there any special color patterns on your organism?
· Draw any special features you think are important.
· Color your picture to closely resemble the organism.

PRAIRIE CRITTER RECORD CARD

Team _____ Activity Site _____
Date _____

Reconstruct your organism here:

HEAD THORAX ABDOMEN

Size: (Draw a line as long as the organism.)

· Are there any special color patterns on your organism?
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PRAIRIE CRITTER RECORD CARD

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· Are there any special color patterns on your organism?
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PRAIRIE CRITTER RECORD CARD

Team _____ Activity Site _____
Date _____

Reconstruct your organism here:

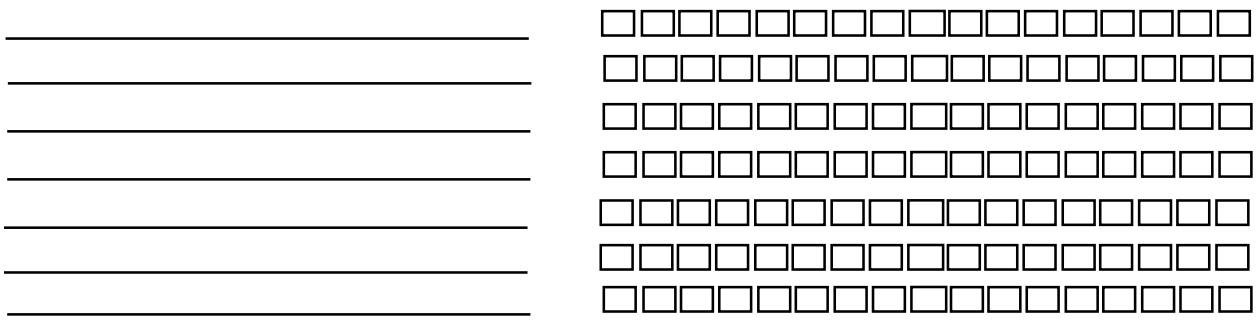
HEAD THORAX ABDOMEN

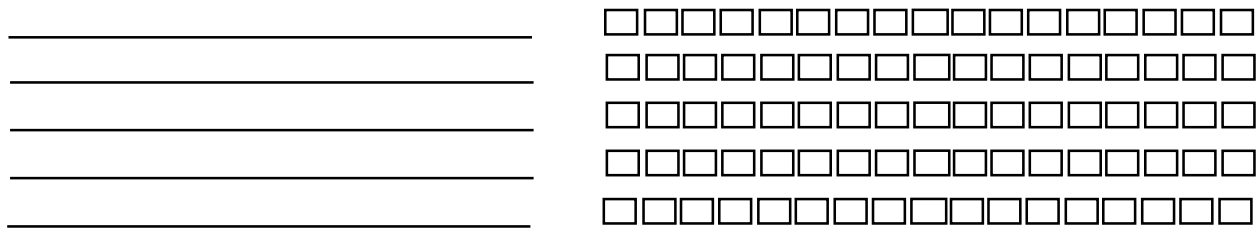
Size: (Draw a line as long as the organism.)

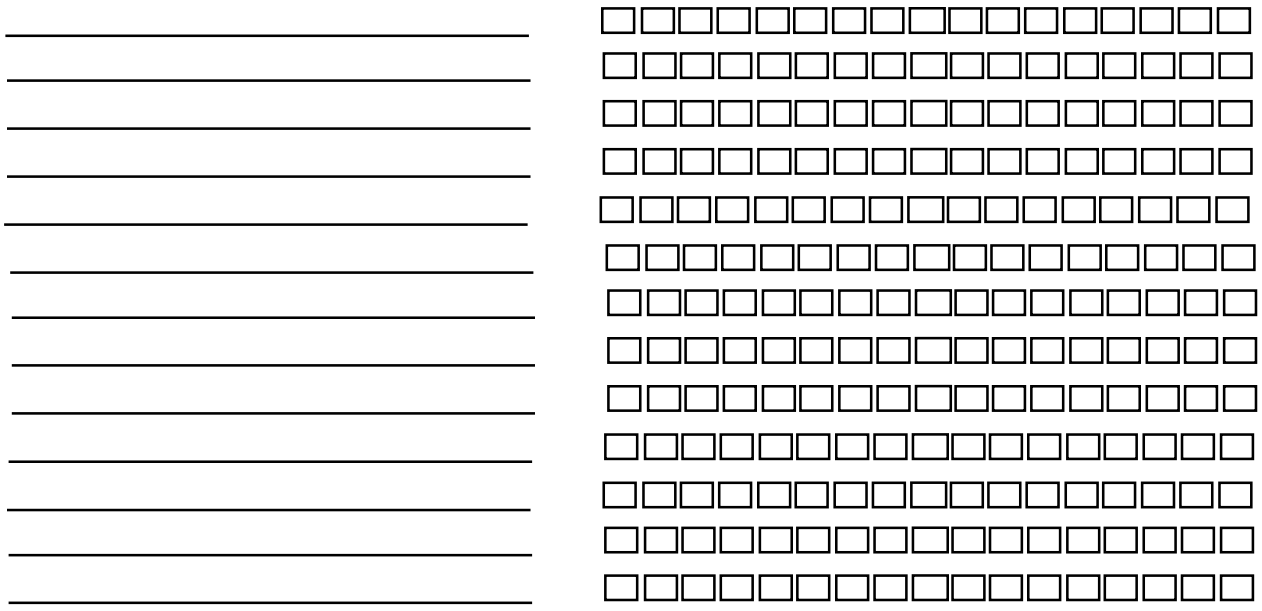
· Are there any special color patterns on your organism?
· Draw any special features you think are important.
· Color your picture to closely resemble the organism.

This form used with permission from Sustainable Agriculture and Wildlife: Piecing Together a Habitat Puzzle.

Observation Grid







From the Ground Up

Target Grades: 9 - 12

SUMMARY: Students will learn the composition of a grass plant by building a three-dimensional model.

OBJECTIVES: Students will be able to identify the parts of a grass plant. Students will be able to identify a few common grasses native to their area. Students will become familiar with the role of grasses in our world.

GROUP SIZE: Any size

DURATION: 3 sessions of 45 minutes each

KEY WORDS: inflorescence, floret, pistil, stamen, glume, palea, lemma, rachilla, auricle, blade, culm, stolon, tiller, node, ligule, and forb.

STANDARDS: *Science Standards*
Abilities necessary to do scientific inquiry
Evolution and equilibrium

Standards for the Language Arts
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion and the exchange of information).

MATERIALS: Copies of the grass parts copied onto colored paper, scissors, transparent tape, newspaper, brads or paper fasteners, hand lenses, several grass plant samples- some of which are flowering, if possible, and copies of the background information to share with your students.

BACKGROUND INFORMATION: A grassland is one example of what ecologists call a biome, which is a broadly defined type of habitat sharing certain characteristics. The earth's terrestrial biomes are tundra, forest, desert and grasslands. The major grassland areas of the world are the sub-Saharan plain of Africa, the pampas of South America, the steppes of Eurasia, much of Australia, and the American Great Plains (of which the Loess Hills prairies are a part).

The French word "prairie" was applied to describe the endless seas of grass of the Great Plains. Grasses, sedges, and rushes cover vast areas of our planet's surface. A great many are widely used species such as rice, sugar cane, bluegrass, corn, wheat, rye and barley.

Grasses are divided into various types, some of which are warm season and others cool season grasses. The United States is divided into tall grass, mid-grass and short grass prairie regions.

Many of the prairies of the Loess Hills area are "'virgin" prairies, that is prairies that have been left alone to develop naturally. Few areas of virgin prairie remain in the United States. The areas that are left are often called "postage stamp" prairies due to their small size. They can be found along some roadsides, or along or in older cemeteries. Virgin prairies have a greater diversity of plant and animal species than do prairie areas that have been disturbed or managed by humans.

In the Loess Hills, the basis for the prairie soil is loess, from the German word that means simply "loose" soil. It is a powdery dirt distributed through the plains by the winds during glaciation. The glaciers receded and the grasses helped make the dust into soil, holding it from the wind with their roots. Most of the grass plant is located below the ground with roots of some species, such as big bluestem, reaching 15 feet deep or more.

There are many misconceptions about grasses- they have no flowers, they have no color, and they all look alike. Careful examination will show that all of these are false ideas.

PROCEDURE:

1. Make copies of the background information on grasses included with this lesson and copies of the parts of a grass plant for the students to assemble during this lesson.

2. Make overheads of "The Grass Plant" and the "Grass Family (Gramineae)" background information sheets. Pass out the copies of the background information. Explain the parts of the grass plant and their functions to your students.

3. Next, pass out the colored copies of the grass plant parts. Have your students cut out the green grass blades. Cut out the ligules from the yellow sheet and tape one on each auricle of each blade. Tape each of these blades on a rolled up tube of newspaper in an alternating fashion so the sheath and auricle clasp around the newspaper which is serving as the stem of the grass plant.

4. Explain to your students that the pattern of how the ligule and auricle clasp the stem of the grass are characteristics used by biologists to classify grasses.

5. Next, cut out all the parts of the grass spikelet. Fold the glumes, lemmas, and palea down the midline of each part. Make a small slit along the dotted line near the bottom of the rachilla and cut out the grain and insert it into this slit. You will note that each part of the spikelet has a "dot" near the bottom. Using a brad, assemble them with the glumes on the outside, then the lemmas, then the palea and finally the rachilla in the center. The brad is also pushed through the dot at the bottom of the inflorescence piece of the cut out to show the students that this assembled spikelet or floret is just one of several in a grass inflorescence or flower cluster. (Before you have the students attach the various parts of the grass flower with a brad, the teacher may want to move through the room with a probe or pointed compass to start the holes.)

6. Now tape the assembled florescence at the top of the rolled up newspaper with the grass blades taped to it. You have now assembled a grass plant, minus the root system.

7. Additional cut up streamers of newspaper or yarn can be taped to the bottom of the grass plant to show how the fibrous root system of the the grass plant spreads out through the soil.

8. Finally, pass out samples of various grasses and the hand lenses to allow students to compare their models to actual grasses. Ask the students to draw and label the parts of the real grasses.

EVALUATION: Have the students use the model to explain and perhaps demonstrate how their assembled grass plant might release pollen to fertilize other grass plants. Students could also use the assembled grass plant to explain how grasses are adapted to factors such as wind and the low moisture levels associated with a prairie biome.

EXTENSIONS:

1 . Have students use resources including the internet to construct a map of Iowa and/or the United States showing the areas that may contain virgin prairie.

2. Next have the students research the findings of the Lewis and Clark expedition to find the areas of virgin prairie in the United States at that time. Have your students compare the two maps and comment on the factors they believe caused the change.

RESOURCES:

Brown, Lauren. (1979). Grasses. New York, NY: Houghton Mifflin Co.

Christiansen, Paul & Mark Müller. (1999). An Illustrated Guide to Iowa Prairie Plants. Iowa City, IA: The University of Iowa Press.

Forey, Pamela & Cecilia Fitzsimons. (1986). An Instant Guide to Wildflowers, New York, NY: Bonanza Books.

Jaques, H.E. (1949). Plant Families: How to Know Them. Dubuque, IA: Wm. C. Brown Publishing Company.

Mutel, Cornelia F. (1989). Fragile Giants. Iowa City, IA: The University of Iowa Press.

Peterson, Roger Tory & Margaret Mckenny. (1968). Field Guide to Wildflowers. New York, NY: Houghton Mifflin Company.

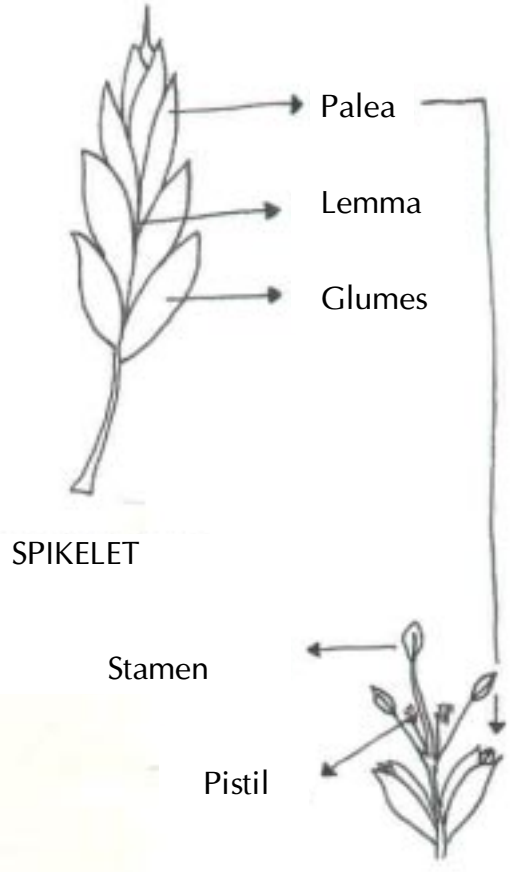
Pohl, Richard W. (1993). Keys to Iowa Vascular Plants, Ames, IA: Iowa State University Press.

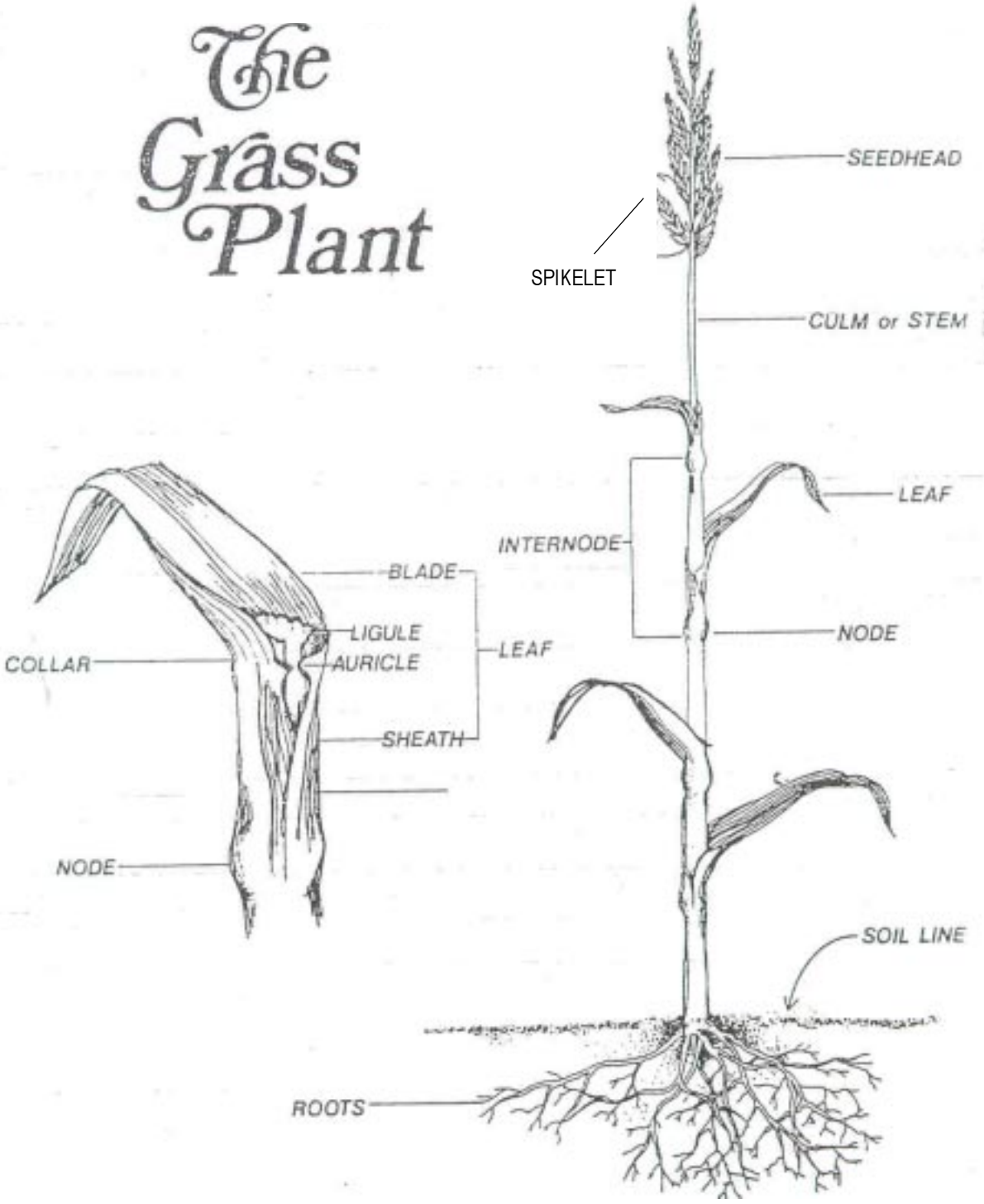
Runkel, Sylan T. & Dean M. Roosa. (1989). Wildflowers of the Tallgrass Prairie. Ames, IA: Iowa State University Press.

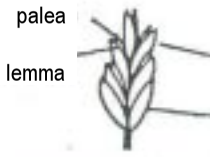
Van Bruggen, Ted. (1971). Grasses and Wildflowers of the Northern Great Plains and Black Hills. Interior, SD: The Badlands Natural History Society.

Walters, Dirk R. & David J. Keil. (1975). Vascular Plant Taxonomy. Dubuque, IA: Kendall Hunt Publishing Company.

Zim, Herbert S., Ph.D. & Alexander C. Martin, Ph.D. (1987). Flowers: A Guide to Familiar American Wildflowers. Racine, WI: Western Publishing Company.




The Grass Plant
SEEDHEAD
SPIKELET
CULM or STEM
LEAF
INTERNODE
NODE
BLADE
LIGULE
AURICLE
LEAF
COLLAR
SHEATH
NODE
SOIL LINE
ROOTS



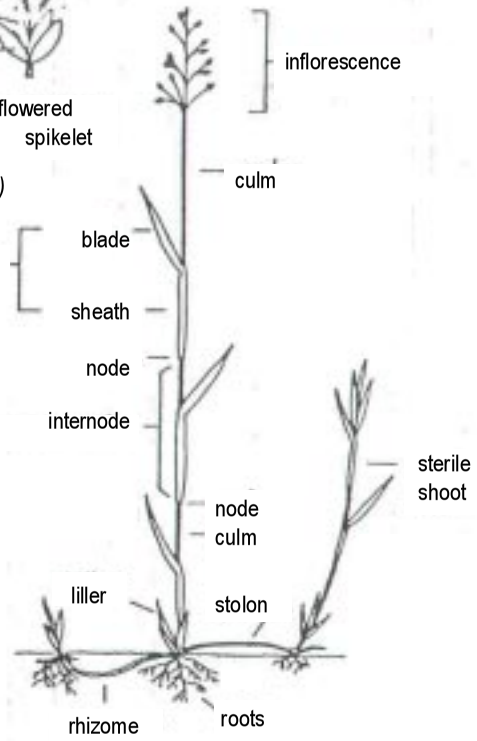
several - flowered spikelet

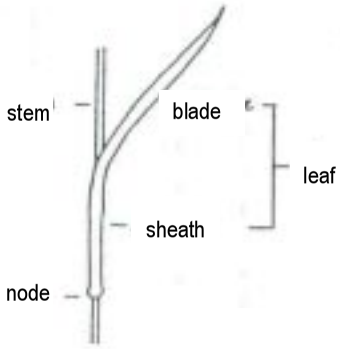
scales with flowers inside

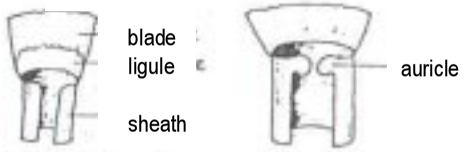
empty scales (glumes)

single - flowered spikelet

Grass flower clusters (spikelets)
flowers arranged in two rows

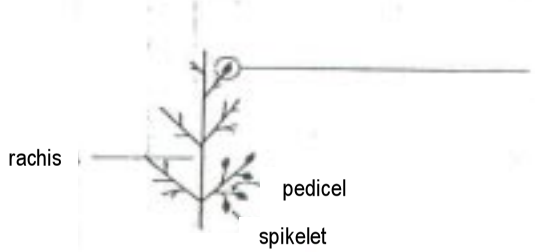




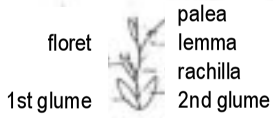


the ligule may have different shapes,
be hairy or be absent

GRASS FAMILY (GRAMINEAE)



inflorescence



a generalized spikelet

BACKGROUND
INFORMATION:

****_Cyperaceae_**: Sedge family: 70-100 genera, 4000-9000 species. Worldwide distribution, but primarily wetlands. "Grassy looking" plants with triangular solid stems, and fused leaf sheaths. Inflorescence of spikelets subtended by a single glume, often aggregated into racemas, spikes, heads, panicle-like or umbell-like clusters.

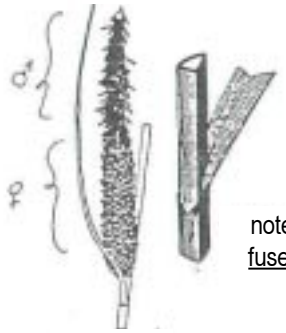
Perianth reduced to bristles or scales, or missing entirely. Stamens 1-3 (rarely 4+), carpels 2-3, fused, fruit an achene enclosed in a sac-like perigynium. *Cyperus:* papyrus; *Carex*: sedges; *Scirpus*: bullrush; *Eleocharis tuberosa* (water chestnut), etc.

****_Poaceae_** (=Gramineae): 600-750 genera, 7500-10,000 species. Herbs, shrubs, trees, or vines. Worldwide distribution, usually of mesic to dry lands. Round stems (usually hollow), leaves with overlapping sheath edges (almost never fused). Inflorescences of spikelets subtended by a pair of bracts, the glumes, and the spikelets gathered into a variety of panicles, including spike-like inflorescences that are really condensed panicles. See drawings for more spikelet terminology. Important characteristics to note for keying:

-- Size and number of veins in the glumes
-- Whether spikelets disarticulate above the glumes (leaving the glumes attached to the inflorescence) or drop enclosed by the glumes (disarticulation below the glumes)
-- Size and number of veins on the lemma and palea
-- Size and shape of the caryopsis
-- Whether the spikelets are terete (round in XS) or flattened parallel or anti-parallel to the glumes
-- Awns: size, number and placement.

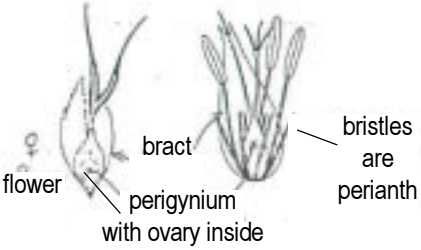
****_Typhaceae:_** Cattail family: 1 genus, 10-15 species, worldwide distribution. Semiaquatic herbs from rhizomes. Inflorescence a double spadix, the terminal portion male, the basal portion female, and the entire inflorescence with a small spathe that drops early. Sepals are scales or bristles; petals are absent. 2-5 stamens or 1 carpel per flower. *Typha*, cattail.

CYPERACEAE



note: sheating fused leaf base

compound spike



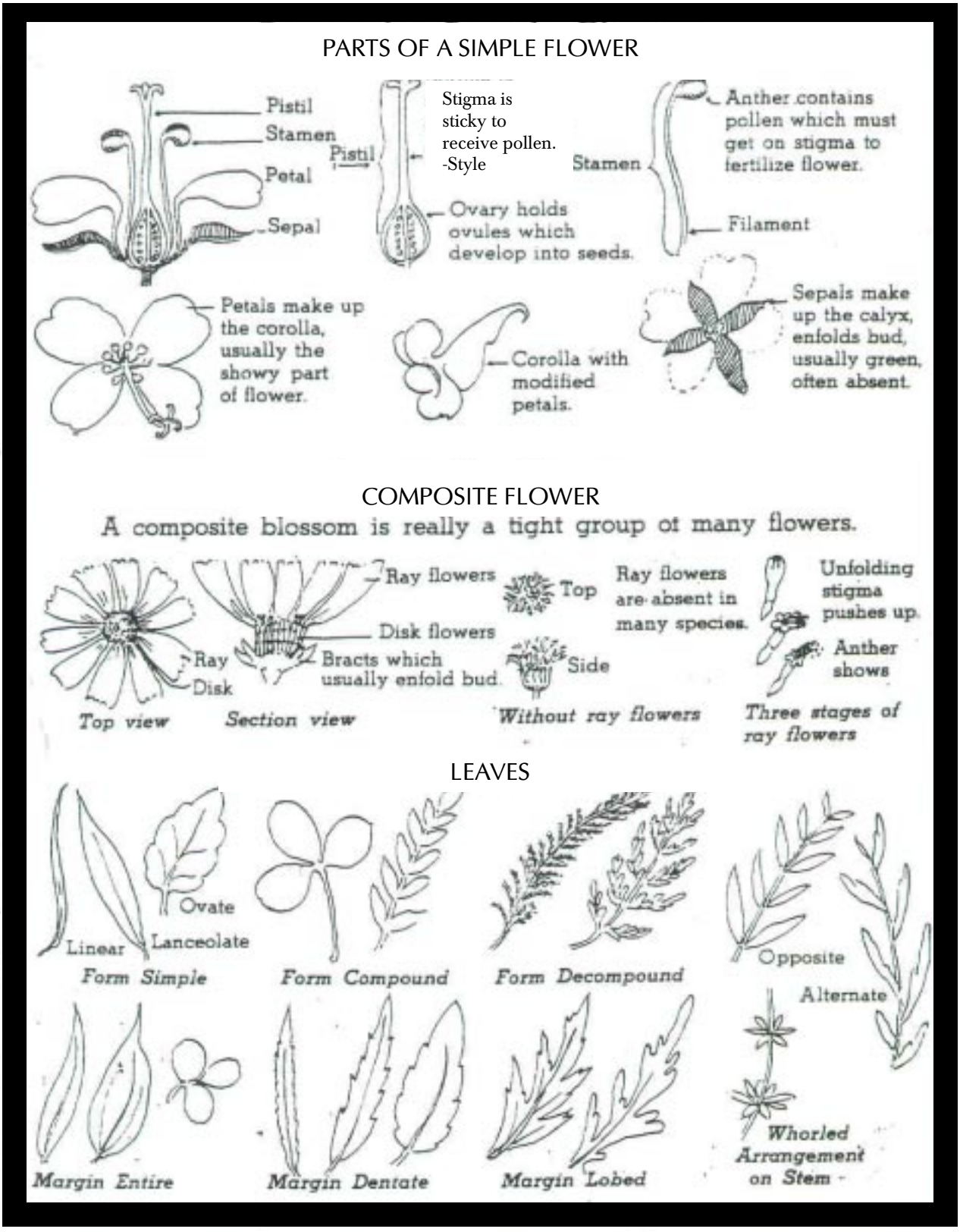
POACEAE

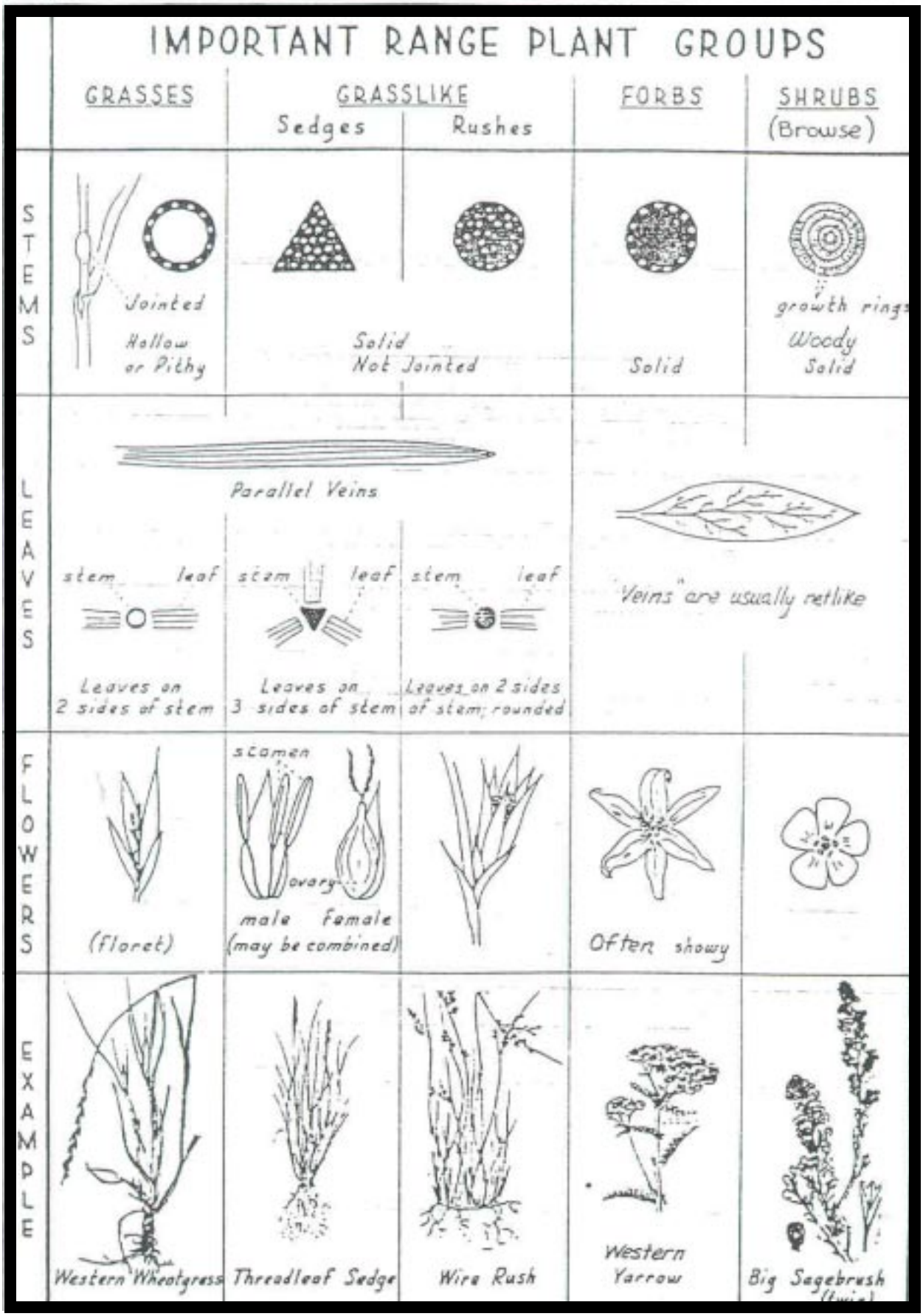
scirpus panicle

scirpus spikelet

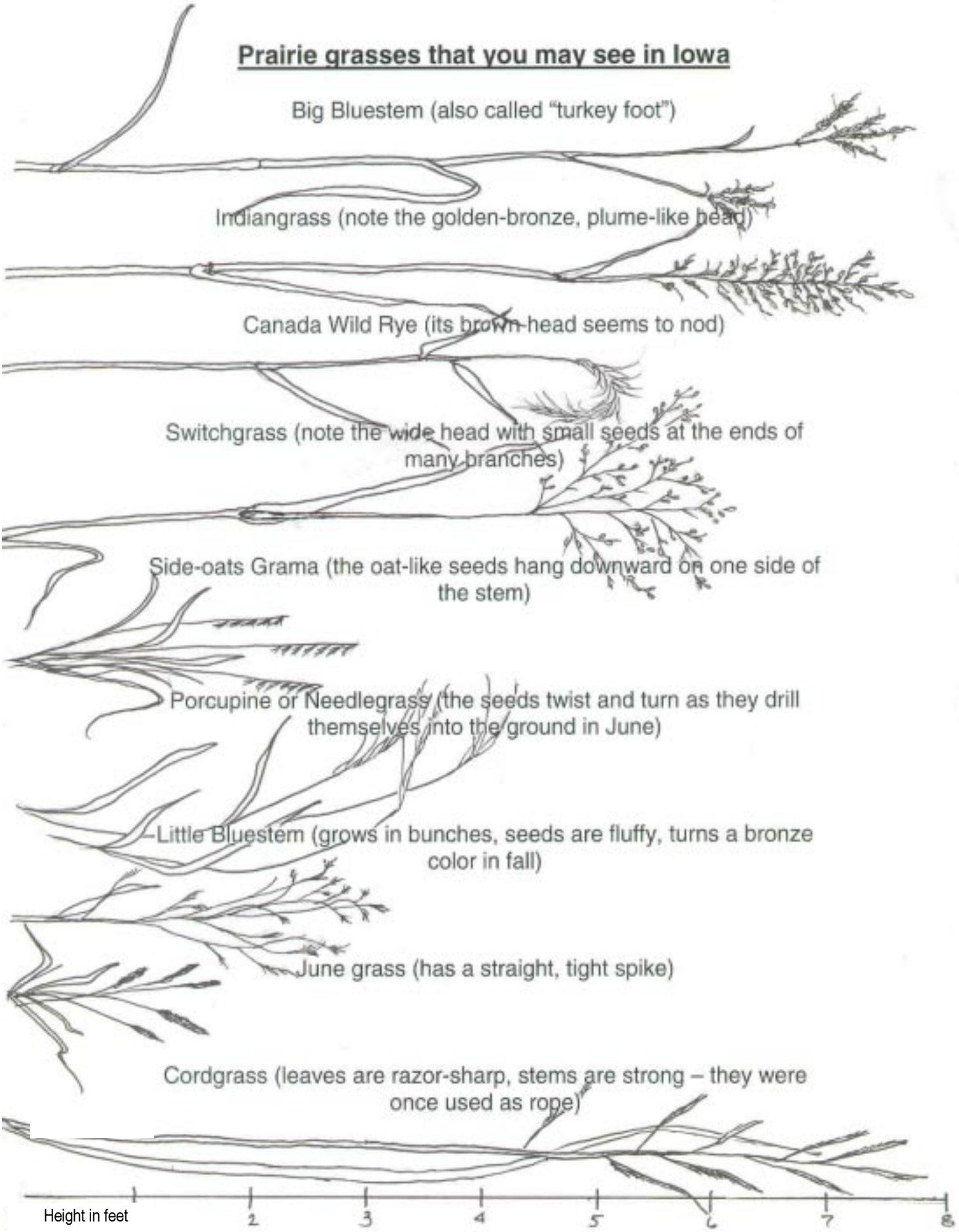
TYPHACEAE

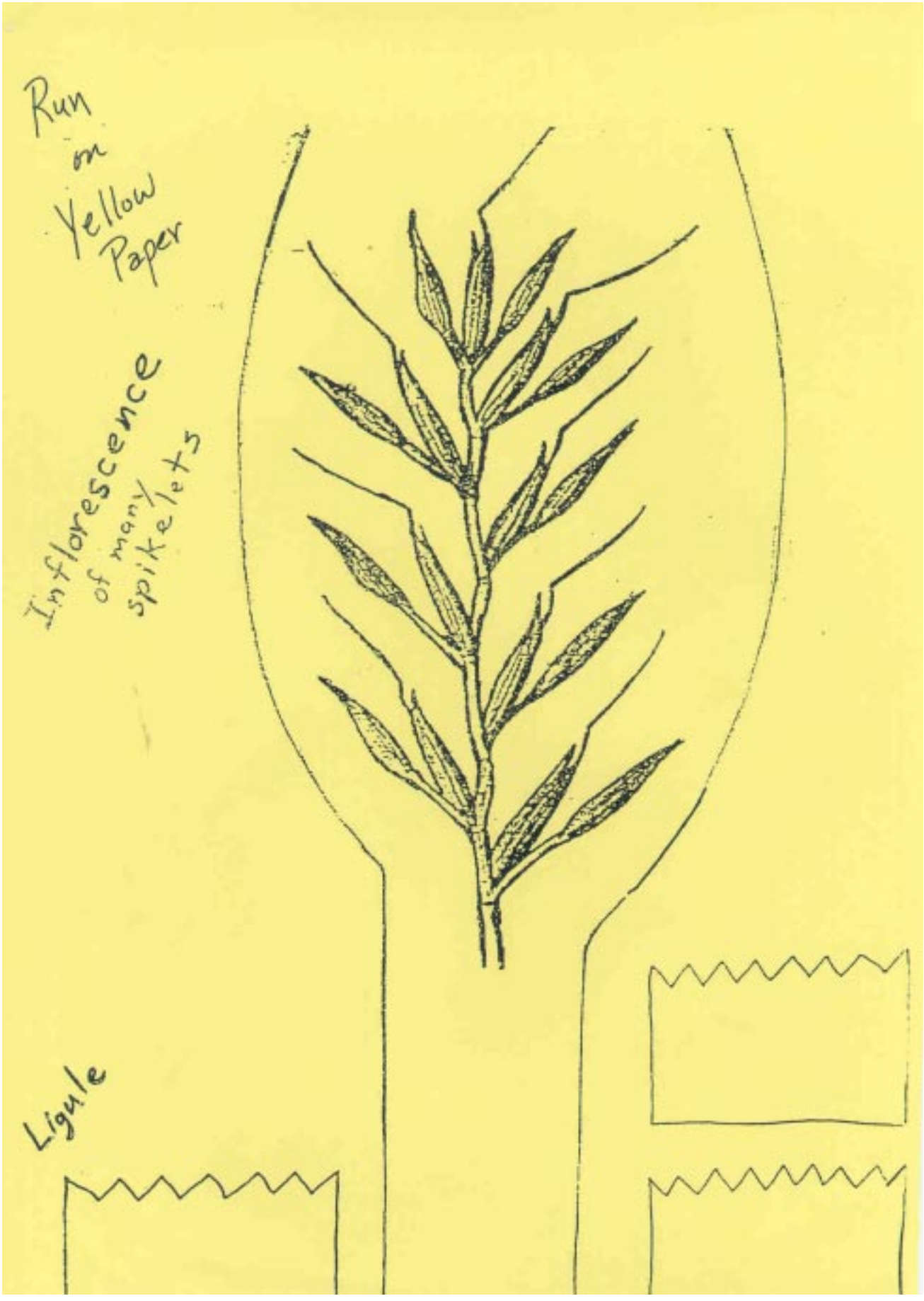
Background Information

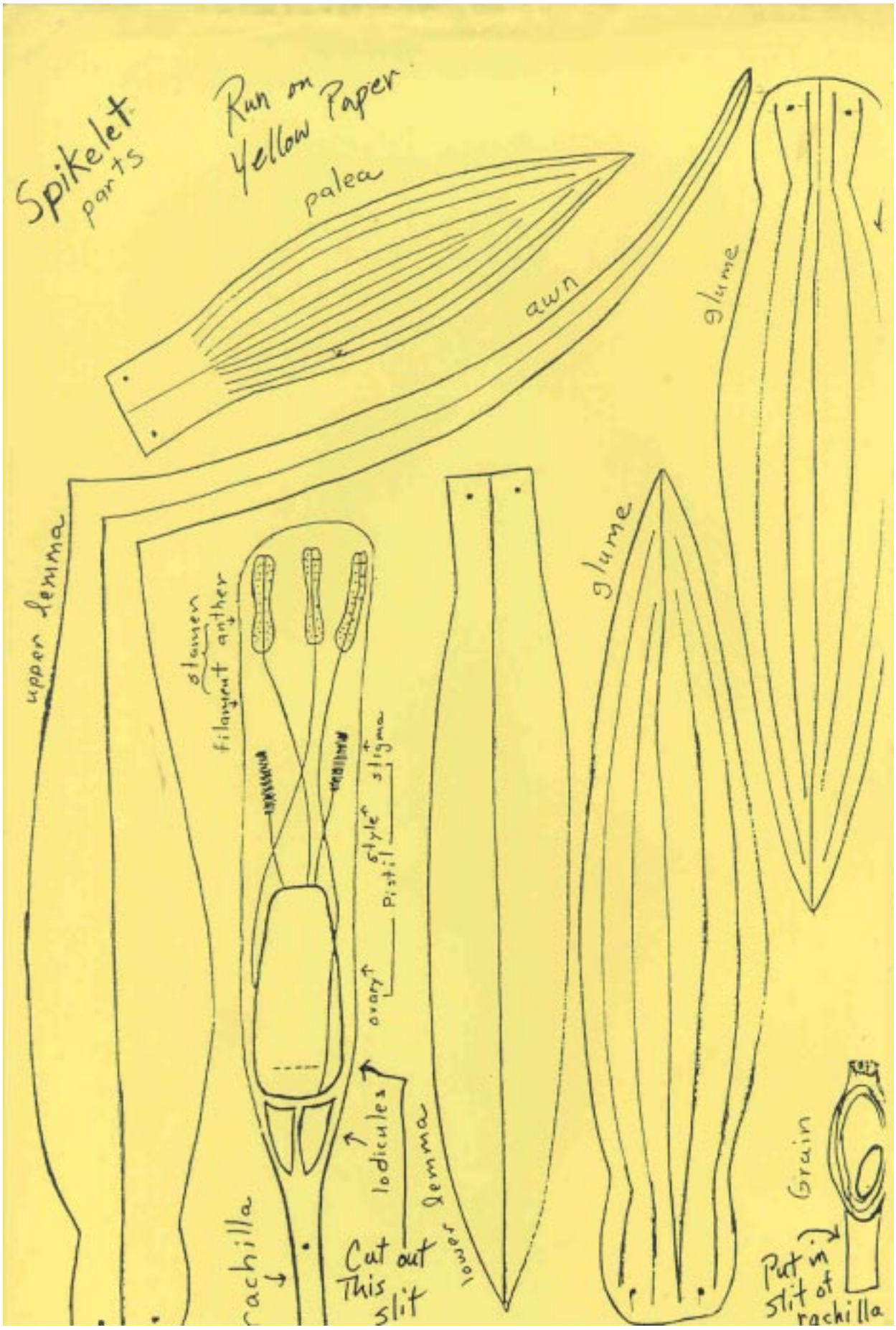


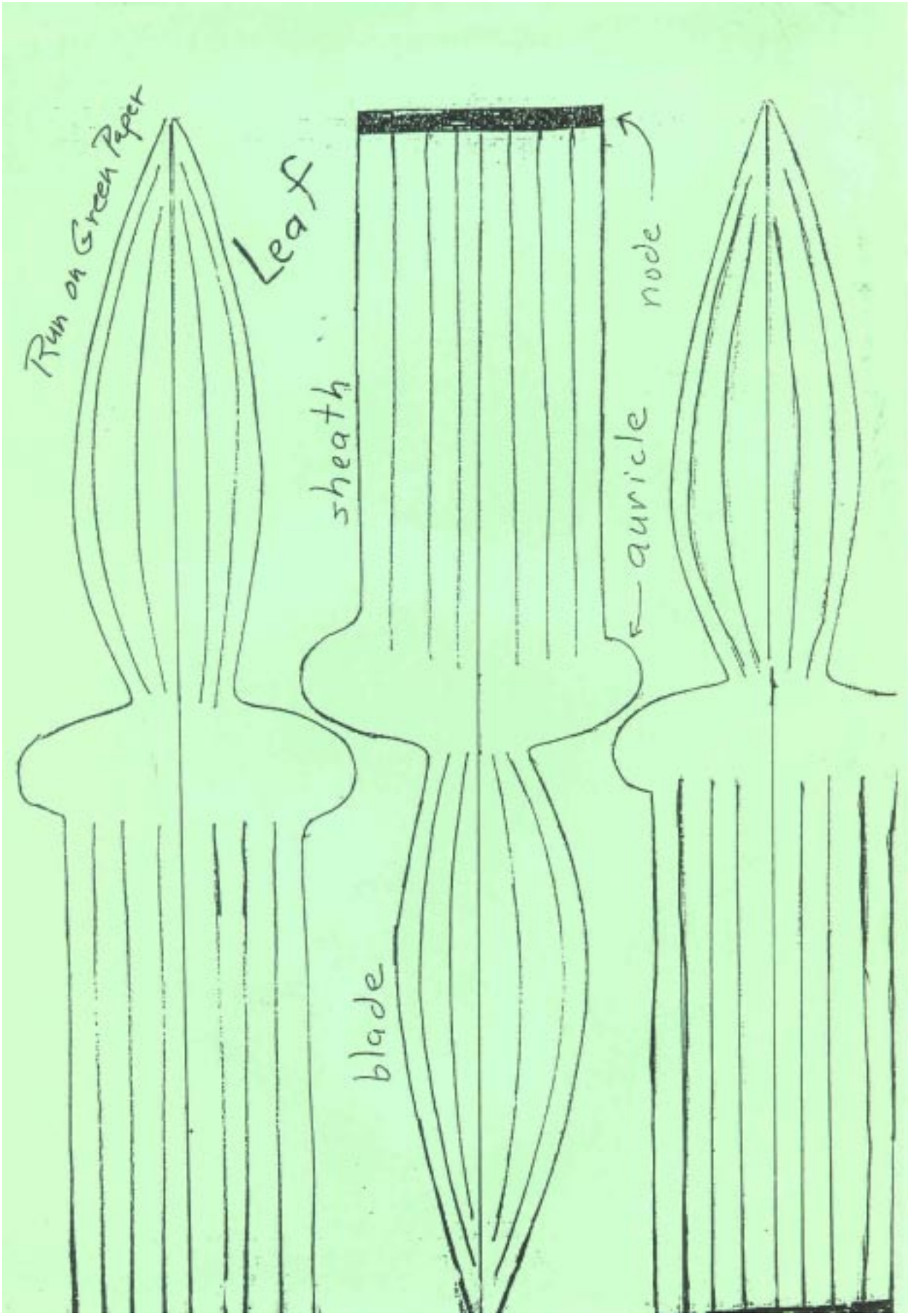

IMPORTANT RANGE PLANT GROUPS
GRASSES
GRASSLIKE
Sedges
Rushes
FORBS
SHRUBS
(Browse)
STEMS
Jointed
Hollow
or Pithy
Solid
Not Jointed
Solid
growth rings
Woody
Solid
LEAVES
Parallel Veins
stem
leaf
Leaves on
2 sides of stem
Leaves on
3 sides of stem
Leaves on 2 sides
of stem; rounded
"Veins" are usually netlike
FLOWERS
(floret)
stamen
ovary
male female
(may be combined)
Often showy
EXAMPLE
Western Wheatgrass
Threadleaf Sedge
Wire Rush
Western
Yarrow
Big Sagebrush

Prairie grasses that you may see in Iowa




Run on Yellow Paper
Inflorescence of many spikelets
Ligule


Spikelet parts
Run on Yellow Paper
palea
awn
glume
glume
upper lemma
stamen
filament
anther
style
stigma
Pistil
ovary
lodicules
lower lemma
rachilla
Cut out This slit
Grain
Put slit on rachilla


Run on Green Paper
Leaf
sheath
auricle
node
blade

The Loess Hills - Who Lived There?

Target Grades: 9 - 12

SUMMARY: Students research the Glenwood culture of the Loess Hills area, write a paper including their research, and design a display to depict one aspect of the Glenwood culture.

OBJECTIVES: Students will conduct research using a minimum of three articles as a basis for a written paper on the Glenwood culture. Students will design and create a display depicting the daily life of the people of the Glenwood culture.

GROUP SIZE: Any size

DURATION: 4-6 sessions of 45 minutes each

KEY WORDS: culture, tradition, climate, agriculture, domesticated, community, subsistence, diet, health, topographic, excavations, cache pits, and artifacts.

STANDARDS:

National History Standards
Students should develop an understanding of the biological and cultural processes that shaped the earliest human communities.

Standards for the English Language Arts
Demonstrate competence in the general skills and strategies of the writing process.
Effectively gather and use information for research purposes.
Demonstrate competence in the general skills and strategies for reading information.

Science Standards
Historical perspectives

National Geography Standards
Understands that culture and experience influence people's perceptions of places and regions.

MATERIALS: Various reference books on the Glenwood culture, copies of the noted articles on the Glenwood culture, internet access if possible, writing materials, various craft materials with which to build the displays.

BACKGROUND INFORMATION: The Glenwood culture was one of the three major village farming cultures in the Loess Hills. To the north, the Great Oasis culture built lodges in clusters inside forts to protect themselves from enemies. Further south, the Mill Creek culture farmed and raised corn along the Missouri River tributaries. Still further south, the Glenwood culture built earth lodges in scattered groupings on the summits, low terraces and valley slopes of the Loess Hills.

The Glenwood culture is believed to have lived in the Loess Hills between approximately 900-1300 A.D. The people were hunters of deer, elk, bison, rabbits, squirrels, turtles and birds. They gathered nuts, berries and seeds. They were also horticulturists, raising squash, corn and beans. They were fishermen as well, as suggested by the bone hooks found in archeological excavations of their dwellings.

PROCEDURE:

1. The students will state a problem which they want to solve regarding the Glenwood culture.

2. The students will use a minimum of three articles as a basis for the research paper they will be required to write.

3. Students will utilize reference books, articles, and the internet to gather data. They will be instructed to: find the facts; find the opinions; find the details; and determine who these people were by looking at their diet, their tools, their resources, etc.

4. Students will use the "Earthlodge Summary" sheets to organize their research.

5. Students will design and create a cover page for their project. The cover page will include the following: a title; a question; a picture; the student's name; the school year; and the class period. The page will be creative and relate to the topic.

6. The students are expected to research a minimum of three resources and fill out a summary sheet for each one. Using the summaries, students are expected to write a three to five page research paper complete with a cover page and a bibliography. Students will be responsible for making handouts which outline the major points of their paper.

7. Students are responsible for designing and creating a display depicting the life of the Glenwood People of the Loess Hills.

8. Finally, students are expected to share their handouts, their papers and their finished displays with the class.

EVALUATION: The included rubric should be used to evaluate the various aspects of this project.

EXTENSIONS:

1. Invite an archaeologist to your classroom to speak about his/her career and/or what he/she knows about the Glenwood culture.

2. Make a timeline depicting major events within this culture.

3. Design a website showing Loess Hills points of interest.

RESOURCES:

Books:

Anderson, Duane. (1975). Western Iowa Prehistory, Ames, IA: Iowa State University Press.

Schermer, Shirley. (1992). Discovering Archaeology, Iowa City, IA: Office of the State Archaeologist.

Articles:

Anderson, Adrian D. (1960). "The Glenwood Sequence- A Local Sequence For a Series of Archaeological Manifestations in Mills County, Iowa". Journal of the Iowa Archeological Society 10(3).

Green, William. (1990). "Glenwood Culture Paleoenvironment and Diet: Analysis of Plant and Animal Remains from the Wall Ridge Earthlodge, Mills County Iowa". Research Papers 15(6). Iowa City, IA: Office of the State Archaeologist.

Zimmerman, Larry J. (1977). "The Glenwood Local Sequence - A Reexamination". Journal of Iowa Archeological Society Iowa City, IA: Office of the State Archaeologist.

Internet Sources:

<hftp:www.usd.edu/anth/midarch.htm> this site is designed to teach about archeology.
<www.azstarnet.com/-shasha-kbro.htm> this site is for the Society for Historical Archeology.

Museums With Archaeological Exhibits:

Mills County History Museum and nearby earthlodge reconstruction
@ (712) 527-9339

Resource Centers:

Iowa Archeological Society -
contact the Office of the State Archaeologist
@ (319) 335-2389.

Office of the State Archaeologist,
Eastlawn,
The University of Iowa
Iowa City, IA 52242
@ (319) 335-2389.

State Historical Society of Iowa
Capital Complex
Des Moines, IA 50319
@ (515) 281-5111

Earthlodge Summary

Name of Source

Title of Article

Author

Date

What is the article about?

What is your reaction to the article?

What are the man ideas of the article?
What specific information did you collect from the article?

Earthlodge Project

ITEM	EXEMPLARY	PROFICIENT	SATISFACTORY
COVER PAGE	A quality cover is included which is appropriate to the topic.	A very good cover is included, not as attractive, but has the information.	A good cover is included, but lacks specific information.
HANDOUTS	All handouts are easy to find and in a structured fashion.	Most handouts are there and most are in order.	The handouts are there, but they are disorganized.
ARTICLES AND SUMMARIES	All information is accurate and supported by strong examples from a variety of sources.	Major points are accurate and supported by some sources.	Some points are accurate, but not supported by a source.
CREATIVE PAGES	Eye appealing, professional, and information packed.	Eye appealing and good information.	Well made, not as attractive, and not as much information.
TYPING AND FORMATTING	Perfect typing balanced pages additional content placed well within the pages.	Sound construction No errors	Good but not exceptional layout Minor errors
PRODUCT KNOWLEDGE	Able to answer all questions relating to the classroom topics.	Able to answer most questions with demonstrable knowledge.	Able to answer questions with some knowledge.
EXHIBITION	Great use of visual aids. Neatly made and convincing. Exhibits many details of the topic.	Very good use of visual aids, not as attractive, but has information.	Good use of visual aids. Display runs smoothly, but lacks specific information.
SOURCES	A variety of resources are correctly recorded.	All resources are correctly recorded.	All resources are recorded, but not in a correct format.

EARTHLODGE PROJECT

ITEM	UNACCEPTABLE		
COVER PAGE	Shows a lack of time spent to make it informative. Too little information.		
HANDOUTS	Lacking many handouts and not organized.		
ARTICLES AND SUMMARIES	Major points are inaccurate or missing.		
CREATIVE PAGES	Serves no real purpose and is inoperable.		
TYPING AND FORMATTING	Poor arrangement, sloppy work, major typing errors.		
PRODUCT KNOWLEDGE	Unable to demonstrate a knowledge of the topic.		
EXHIBITION	Shows a lack of time to make it informative and too little information.		
SOURCES	List of sources incomplete or missing.		

SCORING DESCRIPTIONS:

5	Exemplary	An efficient high quality attempt has been made to demonstrate the outcomes with few errors revealing an outstanding understanding of the outcomes.
4	Proficient	A clear and advanced attempt has been made to demonstrate the outcomes, (with some minor errors) revealing a component understanding of the outcomes.
3	Satisfactory	An adequate attempt has been made to demonstrate the outcomes, (with some factual errors) revealing a sufficient understanding of the outcomes.
N.I.	Needs Improvement	A limited attempt or no attempt has been made to demonstrate the outcomes, and/or major errors have been made revealing a lack of understanding of the outcomes.

The China Connection

Target Grades: 9 - 12

SUMMARY: Students use the internet to research the loess hills in China, and make a connection with their Chinese peers.

OBJECTIVE: Students will be able to compare and contrast the history, use of and preservation of the loess hills in China and in Iowa.

GROUP SIZE: Any number

DURATION: 3 -4 classroom sessions of 45 minutes each

KEY WORDS: loess, glaciers, agriculture and sustainability.

STANDARDS: *National History Standards*
Students should develop an understanding and knowledge of how to analyze chronological relationships and patterns.

National Geography Standards
Understands the physical and human characteristics of place

MATERIALS: Internet access for your students

BACKGROUND INFORMATION: Loess soil is found near most river valleys, but the extensive deposits, 200 feet or more, are found only in western Iowa's Loess Hills and in the loess hills region of the Yellow River Basin in northern China.

Chinese civilization originated about 2,000 B.C. in north China, probably in the loess hills region of the Yellow River Basin, possibly the Tarim Basin. It spread from the interior to the coastal plains of north China, and for about fifteen centuries civilization flourished in this region. It spread to the Yangtze Valley in central China and to Manchuria around 500 B.C. By this time, the original Chinese civilization was disintegrating, and a dark age ensued, from which arose a practically new civilization. The center of this second civilization shifted to the south, and only in medieval and modern times did it reach the southern part of China.

PROCEDURE:

(This lesson should follow earlier lessons of the geology, plant and animal life of the Loess Hills so that students will have a knowledge base for their comparisons to China.)

1. Have students summarize the information they have learned about the Loess Hills under the following categories:

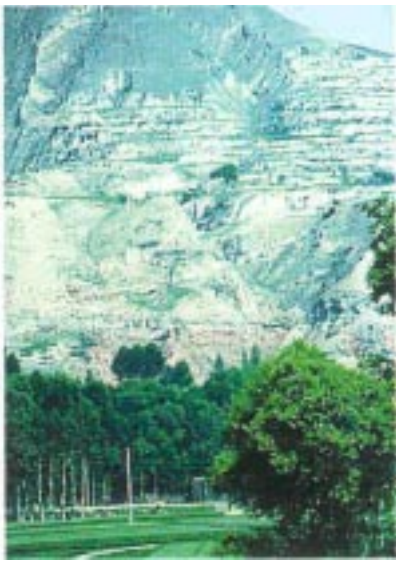
   Geology: what caused the formation of the hills?
   History: who were the early inhabitants and how did they use the land?
   Biology: list several of the unique plants and animals of the hills.
   Ecology: discuss the controversy of the future of the hills--should they be designated a National Park or not?

2. Next, ask your students to make and record predictions about the loess hills of northern China. Tell them to include predictions about each of the four categories they've just examined.

3. Schedule time in your computer lab so that students can utilize the internet to find out about the loess hills of northern China and determine if their predictions were correct. You will also want your students to compare the two landforms to determine if there are similarities or differences. (See resources for a list of web sites to begin with. Perhaps you'll be able to establish correspondence with Chinese students through the internet.)

4. When all students have gathered and shared their research, compare what was learned to what was predicted.

EVALUATION: Have students prepare presentations of their findings. Presentations could be produced through the computer, written and shared orally, or through posters and pamphlets that your students design.



RESOURCES:

<URL:hnp://breeze.sr.unh.edu/hipp/kduwkshp-contents/z-5.html> This site is a summary of existing paleoclimatic records of the highlands of central Asia.

<http://www.soilandhealth.org/01 aglibrary/01o113topsoil.chll.html> This site gives a brief description of early civilizations in the Asian loess hills.

<URL:http//www.cernet.net/wfpfimages.htm> This site shows pictures of China's hills.

Additional Resources

Books

Anderson, Duane. (1975). Western Iowa Prehistory. Ames, IA: Iowa State University Press.

Aplin, Dave & James Pease, Ph.D. (1995). Project Bluestem. Prairie City, IA: Neal Smith National Wildlife Refuge and Prairie Learning Center.

Barker, William T. (1977). Atlas of the Flora of the Great Plains. Ames, IA: Iowa State University Press.

Blobaum, Cindy. (1999). Geology Rocks! Charlotte, VT: Williamson Publishing Company.

Christiansen, Paul & Mark Muller. (1999). An Illustrated Guide to Iowa Prairie Plants. Iowa City, IA: University of Iowa Press.

International Reading Association. (1996). Standards for the English Language Arts. Newark, NJ: National Council of Teachers of English.

Iowa Association of Naturalists. (1993). Iowa Prairies. Ames, IA: Iowa State University Press.

Iowa Public Television. (1997). Earth Trails: Loess. Johnston, IA: Iowa Public Television Interactive Media.

Iowa State University Extension. (1992). Sustainable Agriculture and Wildlife: Piecing Together a Habitat Puzzle, Ames, IA: Iowa State University Press.

Mutel, Cornelia & Mary Swander. (1994). Land of the Fragile Giants. Iowa City, IA: University of Iowa Press.

National Council of Teachers of Mathematics. (1989). Curriculum and Evaluation Standards for School Mathematics. Reston, VA: The National Council of Teachers of Mathematics, Inc.

National Research Council. (1996). National Science Education Standards. Washington, D.C.: National Academy Press.

Prior, Jean C. (1991). Landforms of Iowa. Iowa City, IA: University of Iowa Press.

Schermer, Shirley J. (1992). Discovering Archaeology, Iowa City, IA: Office of the State Archaeologist.

Troeger, Jack Clayton. (1983). From Rift to Drift: Iowa's Story in Stone. Ames, IA: Iowa State University Press.

Filmstrips

Iowa's Prairie Heritage. (1980). Heartland Area Education Agency 11 Media Center. (This filmstrip describes Iowa when settlers arrived at the Loess Hills prairie.)

Videos

Land Between Two Rivers. (1993, Iowa Public Television). Available through your area Education Agency.

Loess Hills- The Fragile Giants. Heartland Area Education Agency 11 Media Center. (60 minutes).

Look to the Hills. Heartland Area Education Agency 11 Media Center. (30 minutes).

Prairie Conversation. Heartland Area Education Agency 11 Media Center. (60 minutes).

Internet Sites

Crouse, David. North Carolina Cooperative Extension Service.
<http:/Awm.ces.ncsu.edu/soilscience/publications.htm> (1997).
This site links to articles about soil facts.

Department of Natural Resources.
<http://www. state. ia. us/government/dnr/organiza/egd/egd.htm>
This site will link you to both soil and energy research o including publications specific to the Loess Hills.

Department of Natural Resources Parks, Recreation and Preserves Division.
<http:www. state. ia. us/government/dnr/organiza/ppd/ waubonsi/htm> (1997).
This site tells about the Loess Hills State Park, has a map of the park, and will link you to other state parks in Iowa.

Engstrom, Mary, Amy Volmer & Larry Zimmerman. Middle School Archaeology.
<http:www.usd.edu/anth/midarch.htm> (1995).
This site will link you to many other similar sites designed to teach about archaeology.

Global School Net Foundation. Ongoing Projects.
<hftp:///archives.gsn.org/ongoing/19950OOz.html> (1997).
This site provides class projects, including one on comparing soil samples with a school in the Loess Hills and your area.

Heinrich, Paul V. Loess Fossils and Loess.
<http:/twww.intersurf.com/-heinrichloessi.html> (1996).
This site gives information on Loess Hills fossils, loess and background information on the Loess Hills themselves.

Heyne, Bruce. Useful Prairie Books.
<hftp:/www.netins. net/ showcase/bluestem/book.htm> (1996).
This site is a bibliography of books and field guides about prairies.

Loess Hills a Natural Landmark.
<hftp:samuel.igbs.uiowa.edu> (1997).
This site tells about the Loess Hills.

Loess Hills Alliance. <loesshillsalliance.com>

Loess Hills Association. <Igsb.uiowa.edu/browse/loess/loess/htm>

Mutel, Cornelia F. & Mary Swander. The Land of the Fragile Giants.
<http://www.usiowa.edu/~uipress/newbooks/mutel&sw.html>
A summary of the book The Land of the Fragile Giants.

Prior, Jean Cutler & Deborah J. Quade. The Loess Hills: A Geologic View.
<http://www.igsb.uiowa.edu/htmls/browse/loess/loess.htm>
This site tells how the Loess Hills were formed, and has geological pictures.

Smith, Mary & Amanda Lenz. Loess Hills.
<http://www. inform. umd.edu/UMS+State/MDK12_Stuff/homepers/emag/loess.html> (1997).
This site has background information on the Loess Hills.

Williams, Randy. Loess Hills Audubon Society.
<http:www.avalon.net/-yams/index.html> (1997)
This site offers links to information on specific birds, butterflies, etc.

Wind Erosion Research Unit.
<http:/www.weru.ksu.edu/> (1997)
This site provides links to publications from the U.S. Department of Agriculture specific to wind erosion.

Organizations

Loess Hills Alliance
53020 Hitchcock Avenue
Lewis, IA 51544

Loess Hills Hospitality Association
109 Oak Street
Moorhead, IA 51558

Loess Hills Welcome Center
Harrison County Village
2931 Monroe Street
Missouri Valley, IA 51555

Naturalists

Fremont County Conservation Board
(712) 374-2347

Harrison County Conservation Board
(712) 647-2785

Mills County Conservation Board
(712) 527-9685

Monona County Conservation Board
(712) 423-2400

Plymouth County Conservation Board
(712) 947-4270

Pottawattamie County Conservation Board
(712) 328-5638

Woodbury County Conservation Board
(712) 258-0838